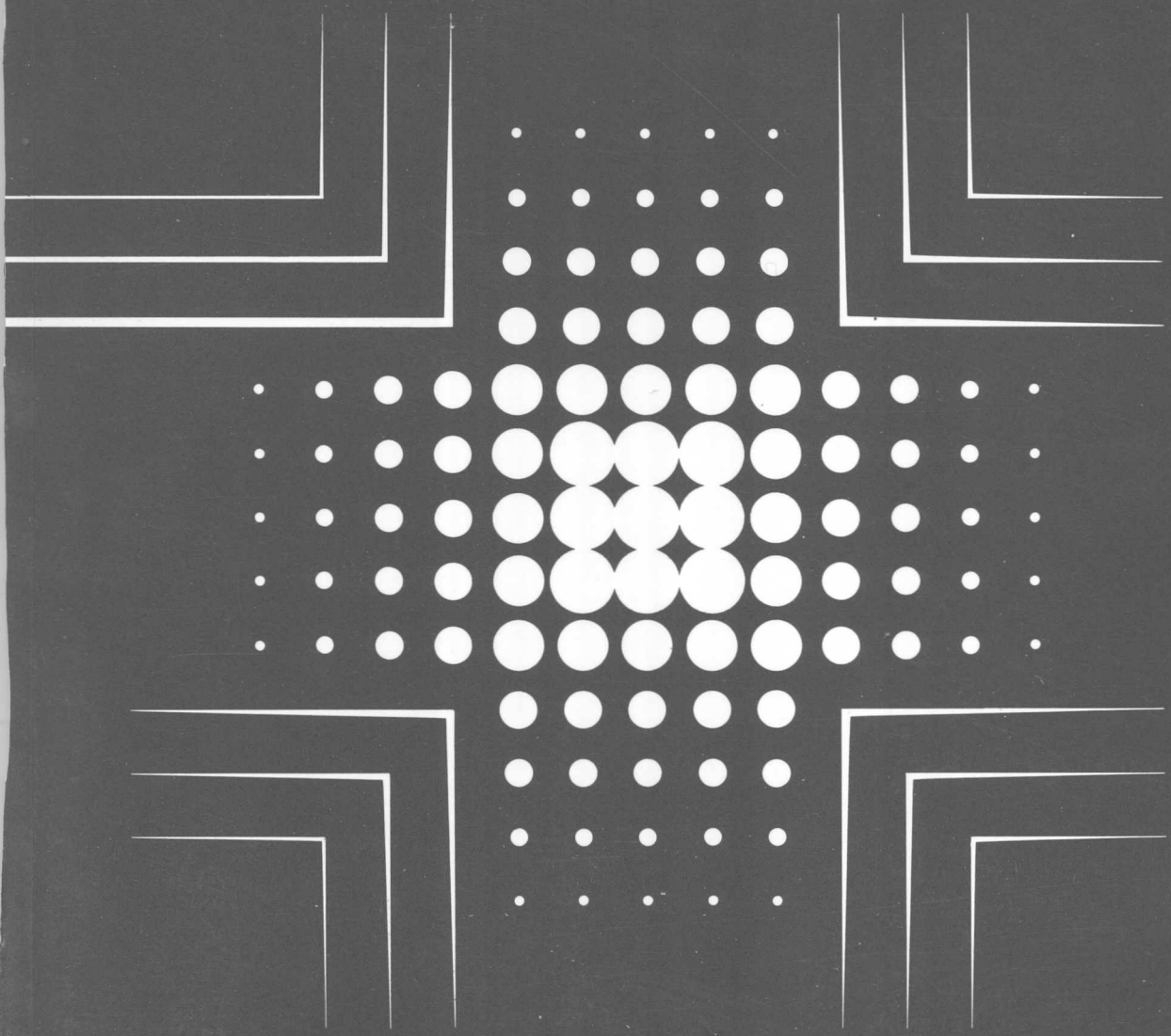
OPTOELECTRONICS
DATA BOOK
1988/89



SHARP

OPTOELECTRONICS DATA BOOK

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PREFACE

In the past decade, optoelectronic devices such as photosensors, photoisolators and solid state relays have been used extensively in industrial equipment and home appliances. More recently, the prevalence of microcomputerized control systems in every field accelerates the demand for high functional, energy saving equipment, resulting in high-speed, high-volume processing of information. As a result, the market for optoelectronic devices as components in microcomputer systems is ever expanding.

We have made great efforts to anticipate future demands and to respond to the user's needs so as to contribute to an efficient new lifestyle.

We are pleased to announce the publication of "Sharp's Optoelectronics Data Book". This data book contains infrared light emitters, light detectors and compound devices produced by Sharp.

- The information contained in the data book is intended to be a general product description. Sharp reserves the right to make change in specifications at any time and without notice.
- Sharp does not assume any responsibility for use of any circuitry described; no circuit patent licenses are implied.
- Unless specified dimensions for tolerance, Max. and Min. in the outline dimension drawings are typical values. As for the detailed dimensions and characteristics, Please refer to our individual specification sheets.

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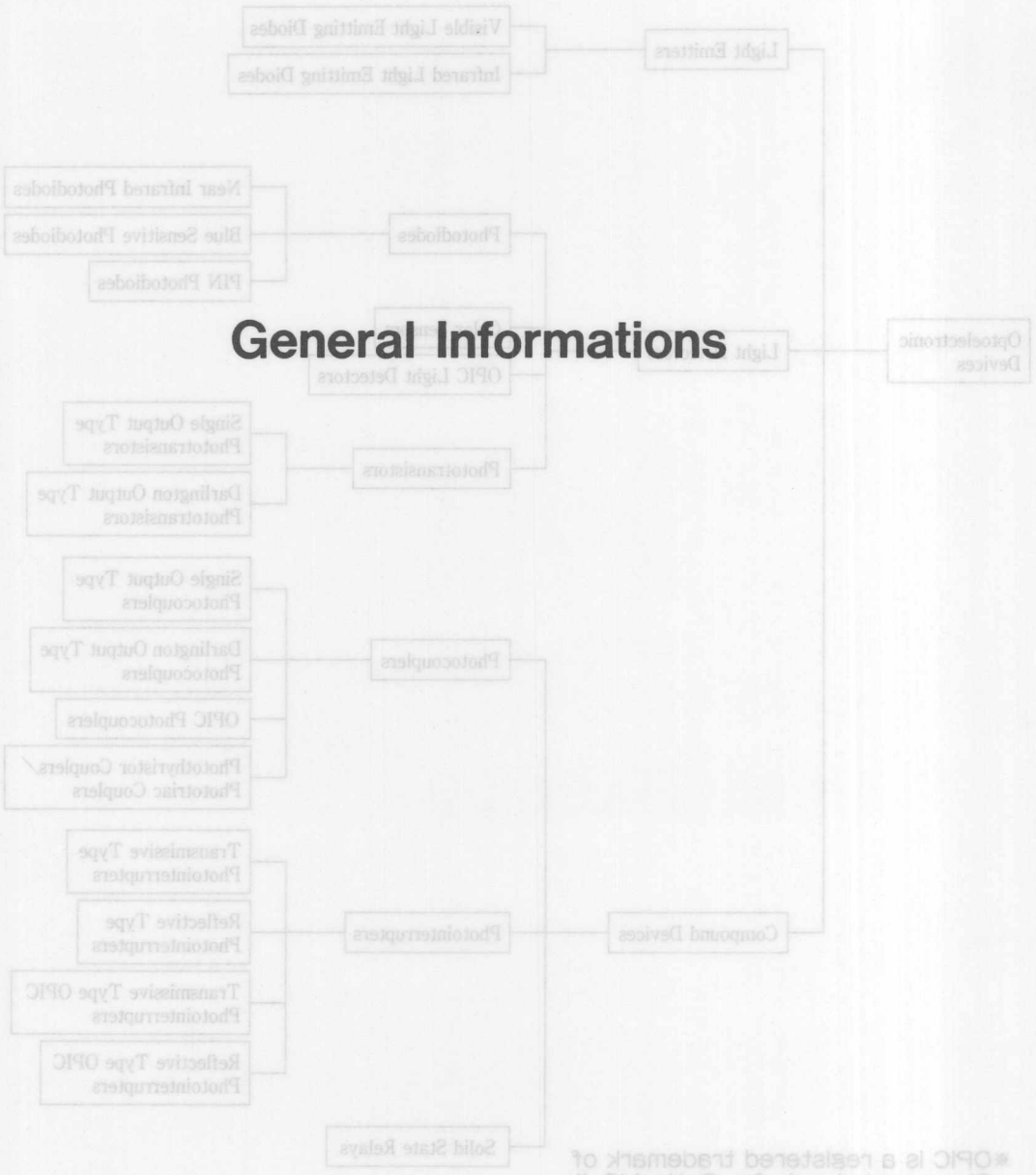
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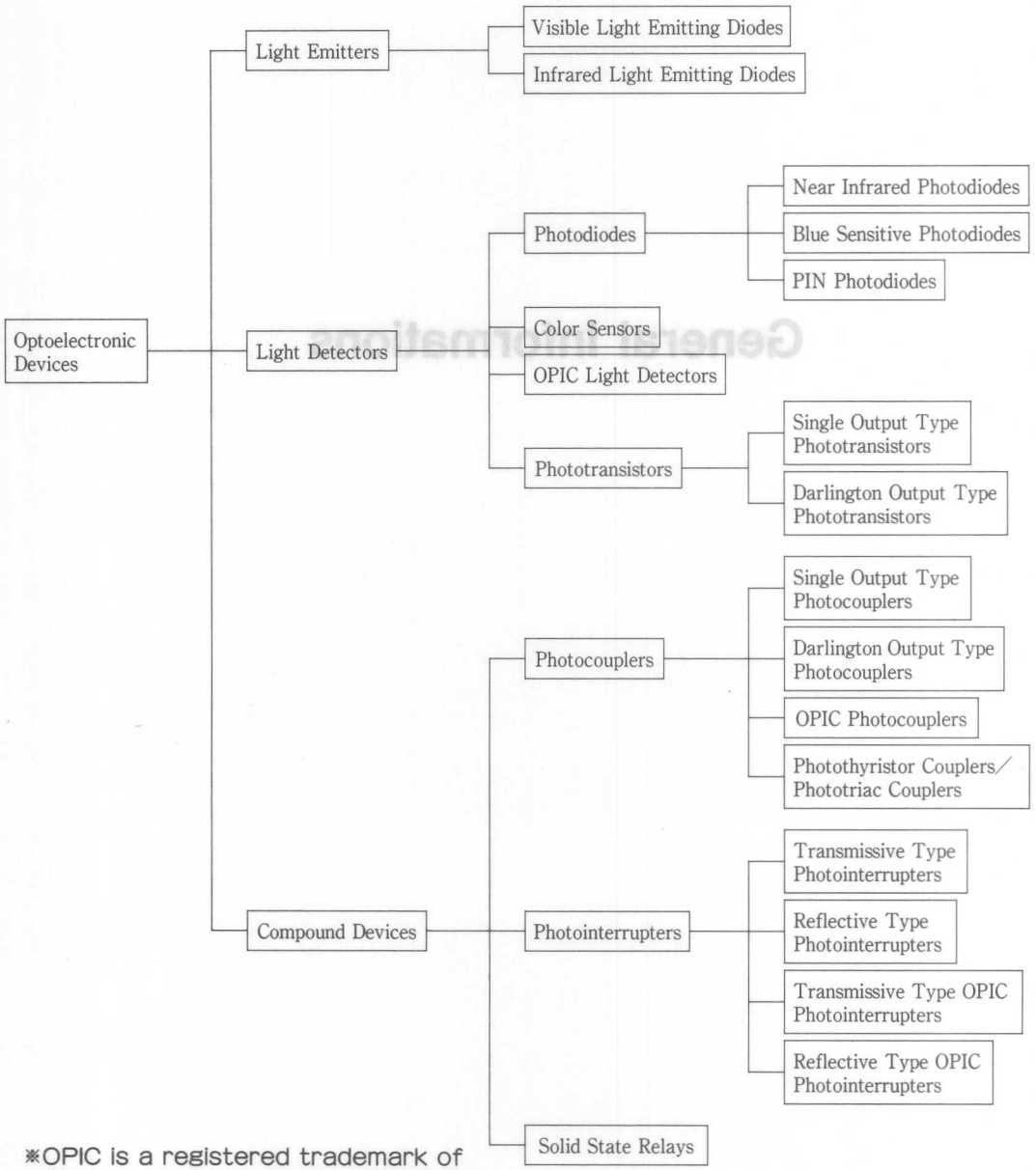
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General Informations



*OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

Classification Chart of Optoelectronic Devices



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

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■ Blue Sensitive Photodiodes

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■ Photocouplers

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S101S03	780
S101S04	780
S112P11	784
S116P11	784
S116P21	787
S116P41	790
S116P42	793
S201D01	776
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S201S03	780
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■ Solid State Relays

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S216P41	790
S216P42	793
S202D81	796
S201DX1	796

Quick Reference Guide

■ Infrared Light Emitting Diodes

Model No.	Features	Package			Outline (mm)				Radiant Flux Φ_e		Peak Emission Wavelength λ_p	Half Intensity Angle $\Delta\theta$	Page
		Metal	Ceramic Base	Resin Mold	ϕ3	ϕ3.2	ϕ5	Side-View	MIN. (mW)	I_F (mA)	TYP.(nm)	TYP.(deg)	
GL360	Compact			○		○			1.5	40	950	±20	68
GL371	Compact			○	○				1.7	40	950	±90	71
GL372	Compact			○	○				1.7	40	950	±70	71
GL420	For photointerrupters			○				○	0.75	20	950	±30	74
GL430	For photointerrupters			○				○	0.5	20	950	±13	77
GL450	Bidirectional emission type for VCRs			○				○	0.7	20	950	±18	80
GL451	Bidirectional emission type for VCRs			○				○	0.7	20	950	±18	80
GL452	Bidirectional emission type for VCRs			○				○	0.7	20	950	±18	80
GL453	Bidirectional emission type for VCRs			○				○	0.7	20	950	±18	80
GL454	Bidirectional emission type for VCRs			○				○	0.7	20	950	±18	80
GL480	For photointerrupters			○				○	0.7	20	950	±13	84
GL513F	For industrial use	○					(TO-18) ○		1.44	100	950	±50	87
GL514	High output type for industrial use	○					(TO-18) ○		3.31	100	950	± 7	87
GL518	High output type for industrial use	○					(TO-18) ○		2.0	50	950	±10	91
GL527	For remote controllers			○			○		10mW/sr	50	940	±25	94
GL528	For remote controllers			○					23mW/sr	50	940	±13	94
GL537	For remote controllers			○			○		13mW/sr	50	950	±25	94
GL538	For remote controllers			○			○		30mW/sr	50	950	±13	94
GL4800	Thin type			○				○	0.7	20	950	±30	97

■ PIN Type Photodiodes

Model No.	Features	Package		Outline (mm)				Visible Light Cut-off	Short Circuit I_{SC} Current		Peak Sensitivity Wavelength λ_p TYP. (nm)	Response Time t_r		Page
		Metal	Resin Mold	ϕ5	ϕ8.5	Side View	DIP		MIN. (μA)	Ev(ℓx)		TYP. (ns)	R_L (Ω)	
PD43PI	General purpose type for consumer appliances		○			○			1	100	920	100	1,000	102
PD49PI	For remote controllers		○			○		○	2.4	100	1,000	—	—	105
PD322PI	For CD, VD		○				○		1.2	100	980	70	1,000	108
PD410PI	For remote controllers		○			○		○	2.5	100	1,000	200	1,000	111
PD481PI	For remote controllers		○			○		○	3.5	100	960	—	—	105
PD663PS	For CD, VD		○				○		0.34/0.08	1,000	840	—	—	114
PD666PS	For CD, VD		○				○		0.4/0.07	1,000	840	—	—	114

■ Blue Sensitive Photodiodes (BS Series)

Model No.	Features	Package			Outline (mm)					Short Circuit Current I_{sc}		Peak Sensitivity Wavelength λ_p TYP. (nm)	Page
		Metal	Ceramic	Resin	ϕ5.9	ϕ8	ϕ8.1	ϕ12.4	□19.0	MIN. (μA)	Ev(ℓx)		
BS100C	Infrared light cut-off type for measuring exposure light		○		○					0.14	100	560	117
BS100D	For measuring exposure light		○		○					0.8	100	880	119
BS112	For industrial use	○					(TO-5) ○			5.5	100	800	121
BS120	Infrared light cut-off type for measuring exposure light			○	○					0.14	100	560	124
BS142	For industrial use	○						○		18	100	800	121
BS500A	For measuring exposure light		○			○				3.3	100	850	126
BS500B	Infrared light cut-off type for measuring exposure light		○			○				0.4	100	560	128
BS501A	For measuring exposure light		○			○				3.3	100	850	126
BS520	Infrared light cut-off type for measuring exposure light			○		○				0.4	100	560	130
BS521	Infrared light cut-off type for measuring exposure light			○		○				0.65	100	560	130
BS530F	High sensitivity type for measuring instruments		○						○	7.0	100	600	132
BS530G	High sensitivity type for measuring instruments		○						○	35.0	100	800	132
BS530UV	For measuring ultraviolet radiation light		○						○	35.0	100	800	132

■ Blue Sensitive Photodiodes (SBC Series)

Model No.	Features	Package			Outline (mm)	Active Area (mm^2)	Short Circuit Current I_{sc} MIN. (μA)	Open Circuit Voltage V_{oc}		Peak Sensitivity Wavelength λ_p TYP. (nm)	Page
		Metal	Resin	Others				MIN. (V)	Ev(ℓx)		
SBC102	For industrial use	○			ϕ15.0	44	15.5	0.18	100	750	134
SBC111	For industrial use		○		ϕ27.5	314	110	0.18	100	750	134
SBC255	For installation into equipment			○	2.5×5	12.5	4.4	0.18	100	750	134
SBC541	For industrial use		○		15.9×40	200	70	0.18	100	750	134

■ Color Sensors

Model No.	Features	Package		Outline (mm)		Reverse Voltage V_R (V)	Dark Current I_d MAX.(nA)	Terminal Capacitance		Short Circuit Ratio I_{sc2}/I_{sc1}, TYP.		Page
		Metal	Resin Mold	ϕ4.7	Side View			Ct_1 TYP.(pF)	Ct_2 TYP.(pF)	λ=600nm	λ=900nm	
PD150	For color reading	○		○		5	10	200	100	0.25	4.5	137
PD151	For color reading	○		○		5	10	200	100	0.25	4.5	137
PD152	For VCR cameras		○		○	5	10	300	100	0.25	4.5	142
PD153	For color reading	○		○		5	5	300	100	0.24	5.1	146

■ OPIC Light Detectors

Model No.	Features	Package	Operation		Threshold Illuminance		Propagation Time				Page
			Low Level when shielded	High Level when shielded	E_{VLH} TYP.(ℓx)	E_{VHL} TYP.(ℓx)	t_{PLH} TYP.(μs)	t_{PHL} TYP.(μs)	Ev(ℓx)	R_L(kΩ)	
IS431	Totem pole output type	Epoxy resin		○	10	15	5	3	50	0.28	150
IS432	Totem pole output type	Epoxy resin	○		15	10	3	5	50	0.28	150
IS435	General purpose type	Epoxy resin		○	10	15	5	3	50	0.28	154
IS436	General purpose type	Epoxy resin	○		15	10	3	5	50	0.28	154
IS437	Open collector output type	Epoxy resin		○	10	15	5	3	50	0.28	158
IS438	Open collector output type	Epoxy resin	○		15	10	3	5	50	0.28	158
IS440	Impervious to external disturbing lights, light modulation type	Epoxy resin		○	—	—	400	400	—	—	162
IS441F	Impervious to external disturbing lights, light modulation type	Epoxy resin		○	—	—	400	400	—	—	162
IS445	Linear output, side view type	Epoxy resin	—	—	—	—	—	—	—	—	166
IS450	Impervious to external disturbing lights, light modulation type	Epoxy resin		○	—	—	—	—	—	—	168
IS455	Linear output, top view type	Epoxy resin	—	—	—	—	—	—	—	—	166
IS486	Built-in amp. type	Epoxy resin	○		15	10	3	5	50	0.28	173

■ Phototransistors

Model No.	Features	Package			Outline (mm)				With Base Terminal	Visible Light Cut-off	*1Output		Collector Current I_C		Peak Sensitivity Wavelength λ_p TYP.(nm)	Half Intensity Angle $\Delta\theta$ TYP. (deg.)	Page
		Metal	Ceramic Base	Resin Mold	φ3	φ3.2	φ5	Side View			SPT	DPT	MIN. (mA)	E_e (mW/cm²)			
PT360	Compact			○		○					○		0.075	0.52	800	±20	178
PT360F	Compact, high sensitivity			○		○				○	○		0.075	0.52	860	±20	178
PT361	Compact, high sensitivity			○		○						○	0.1	0.01	800	±20	181
PT361F	Compact, high sensitivity			○		○				○		○	0.1	0.01	860	±20	181
PT370	Compact			○	○						○		0.1	100ℓx	800	±45	184
PT371	Compact			○	○						○		0.1	100ℓx	800	±65	184
PT372	Compact, high sensitivity			○	○							○	3	100ℓx	800	±70	184
PT420F	For VCR tape-end detection			○				○		○	○		0.4	1	860	±40	189
PT430	For photointerrupters			○				○			○		0.4	1	800	±13	192
PT430F	For photointerrupters			○				○		○	○		0.25	1	860	±13	192
PT431	High sensitivity type for photointerrupters			○				○				○	2	0.1	800	±13	196
PT431F	High sensitivity type for photointerrupters			○				○		○		○	1.3	0.1	860	±13	196
PT480	For photointerrupters			○				○			○		0.4	1	800	±13	200
PT480F	For photointerrupters			○				○		○	○		0.25	1	860	±13	200
PT481	High sesitivity type for photointerrupters			○				○				○	1.5	0.1	800	±13	204
PT481F	High sensitivity type for photointerrupters			○				○		○		○	0.9	0.1	860	±13	204
PT483F1	Long lead type for VCR			○				○		○		○	1.5	0.1	860	±13	204
PT491	Compact			○				○				○	0.3	2ℓx	800	±40	208
PT491F	Compact			○				○		○		○	0.2	2ℓx	860	±40	208
PT493	Compact			○				○				○	0.3	2ℓx	800	±40	208
PT493F	Compact			○				○		○		○	0.2	2ℓx	860	±40	208
PT501	For industrial use	○					(TO-18) ○				○		2.5	10	800	± 6	212
PT510	For industrial use	○					(TO-18) ○		○		○		2.5	10	800	± 6	212
PT550	High sensitivity type for industrial use	○					(TO-18) ○		○			○	3	0.1	800	± 6	216
PT550F	High sensitivity type for industrial use	○					(TO-18) ○		○			○	3	1	800	±50	216
PT4800	Thin type			○				○					0.12	1	800	±35	220
PT4800F	Thin type			○				○		○			0.08	1	860	±35	220
PT4810	Thin type			○				○					0.45	1	800	±35	220
PT4810F	Thin type			○				○		○			0.27	1	860	±35	220
PT4850F	Thin type			○				○		○			0.12	1	860	±35	220

*1 SPT: Single transistor output
DPT: Darlington transistor output

■ Photocouplers (PC100 Series) . . VDE Approved

Model No.	Features	Package		Clearance Creepage Distance MIN.(mm)	Internal Isolation Distance MIN.(mm)	*1Output	With Base Terminal	Isolation Voltage V_{iso} (Vrms)	Current Transfer Ratio CTR		Response Time t_r		Page
		6-pin DIP	6-pin DIP (Special)			SPT			MIN. (%)	I_F(mA)	TYP. (μs)	R_L(Ω)	
PC100	Long creepage distance type		○	10.5	2.0	○	○	5,000	25	10	6	100	228
PC101	Long creepage distance type		○	10.5	2.0	○		5,000	25	10	6	100	228
PC110	Long creepage distance type	○		8.0	0.5	○	○	5,000	50	5	4	100	233
PC111	Long creepage distance type	○		8.0	0.5	○		5,000	50	5	4	100	233
PC112	Long creepage distance type	○		8.0	0.5	○	○	5,000	40	10	4	100	233
PC113	Long creepage distance type	○		8.0	0.5	○		5,000	40	10	4	100	233

■ Photocouplers (PC200 Series) . . Mini-flat Package Type

Model No.	Features	Package	*1Output	Isolation Voltage V_{iso} (Vrms)	Current Transfer Ratio CTR		Turn-on Time t_{on}		Page
			SPT		MIN. (%)	I_F(mA)	MAX. (μs)	R_L(Ω)	
PC219	Bidirectional linear output	5-pin mini-flat package	○	2,000	50	5	50	50	239

■ Photocouplers (PC300 Series) . . Mini-flat, Opaque Package Type

Model No.	Features	Package			Output		Isolation Voltage V_{iso} (Vrms)	Current Transfer Ratio CTR		Response Time t_r		Page
		4-pin mini-flat	8-pin mini-flat	16-pin mini-flat	SPT	DPT		MIN. (%)	I_F(mA)	TYP. (μs)	R_L(Ω)	
PC314(Z)(T)	AC input response	○			○		2,500	20	±1	4	100	242
PC3D14	AC input response, 2-ch		○		○		2,500	20	±1	4	100	242
PC3Q14	AC input response, 4-ch			○	○		2,500	20	±1	4	100	242
PC315(Z)(T)	High sensitivity	○				○	2,500	600	1	60	100	246
PC3D15	High sensitivity, 2-ch		○			○	2,500	600	1	60	100	246
PC3Q15	High sensitivity, 4-ch			○		○	2,500	600	1	60	100	246
PC316(Z)(T)	High collector-emitter voltage	○			○		2,500	50	5	4	100	250
PC3D16	High collector-emitter voltage, 2-ch		○		○		2,500	50	5	4	100	250
PC3Q16	High collector-emitter voltage, 4-ch			○	○		2,500	50	5	4	100	250
PC317(Z)(T)	General purpose	○			○		2,500	50	5	4	100	254
PC3D17	General purpose, 2-ch		○		○		2,500	50	5	4	100	254
PC3Q17	General purpose, 4-ch			○	○		2,500	50	5	4	100	254

■ Photocouplers (PC4N Series) . . General Purpose 4N Series

Model No.	Features	Package	*1Output		With Base Terminal	Isolation Voltage V_{iso} (Vrms)	Collector-emitter Voltage V_{CEO} (V)	Current Transfer Ratio CTR		Response Time t_r		Turn-on Time t_{on}		Page
		6-pin DIP	SPT	DPT				MIN. (%)	I_F (mA)	TYP. (μs)	R_L (Ω)	MAX. (μs)	I_C (mA)	
PC4N25V	General purpose type	○	○		○	2,500	30	20	10	3	100	—	—	258
PC4N26V	General purpose type	○	○		○	1,500	30	20	10	3	100	—	—	258
PC4N27V	General purpose type	○	○		○	1,500	30	10	10	3	100	—	—	258
PC4N28V	General purpose type	○	○		○	500	30	10	10	3	100	—	—	258
PC4N29V	High transfer efficiency type	○		○	○	2,500	30	100	10	—	—	5	50	262
PC4N30V	High transfer efficiency type	○		○	○	1,500	30	100	10	—	—	5	50	262
PC4N32V	High transfer efficiency type	○		○	○	2,500	30	500	10	—	—	5	50	262
PC4N33V	High transfer efficiency type	○		○	○	1,500	30	500	10	—	—	5	50	262
PC4N35V	General purpose type	○	○		○	3,550	30	100	10	—	—	3	2	266
PC4N36V	General purpose type	○	○		○	2,500	30	100	10	—	—	3	2	266
PC4N37V	General purpose type	○	○		○	1,500	30	100	10	—	—	3	2	266

*1 SPT: Single transistor output
DPT: Darlington transistor Output

Lead forming type (VI type) is available in addition to the basic models.

■ Photocouplers (PC500/PC600 Series)

Model No.	Features	Package		*2Output		Isolation Voltage V_{iso} (Vrms)	Current Transfer Ratio CTR		Response Time t_r		Page
		4-pin PWB Mounting	6-pin DIP	SPT	FET		MIN. (%)	I_F(mA)	TYP. (μs)	R_L(Ω)	
PC511	Long creepage distance type	○		○		5,000	10	20	3	100	290
PC619	Bidirectional linear output type		○		○	2,000	—	—	—	—	294

*2 SPT: Single transistor output
FET: Bidirectional analog FET output

■ Photocouplers (PC700 Series) . . DIP 6-pin, V_{iso}: 5 kVrms Type

Model No.	Features	Package	*1Output		With Base Terminal	Isolation Voltage V_{iso} (Vrms)	Collector-emitter voltage V_{CEO} (V)	Current Transfer Ratio CTR		Response Time t_r		Page
		6-pim DIP	SPT	DPT				MIN. (%)	I_F (mA)	TYP. (μs)	R_L (Ω)	
**PC702V	High collector-emitter voltage type	○	○		○	5,000	70	40	10	2	75	297
**PC703V	High collector-emitter voltage type	○	○		○	5,000	70	40	10	4	100	301
**PC713V	General purpose type	○	○		○	5,000	35	50	5	4	100	305
**PC714V	General purpose type	○	○			5,000	35	50	5	4	100	305
**PC715V	High transistor efficiency type	○		○		5,000	35	600	1	60	100	309
**PC716V	High transistor efficiency type	○		○		5,000	35	1,000	1	130	100	313
**PC723V	High collector-emitter voltage type	○	○		○	5,000	80	50	5	6	100	317
PC724V	High allowable input current type	○	○			5,000	35	20	100	4	100	321
**PC725V	High collector-emitter voltage high transfer efficiency type	○		○	○	5,000	300	1,000	1	100	100	325
*PC733	AC input type	○	○		○	5,000	35	15	± 1	4	100	329
PC733H	AC input, high allowable input current type	○	○		○	5,000	35	20	±100	4	100	333

** Lead forming type (VI type or W type) is available in addition to the basic models.
* Lead forming type (I type) is available in addition to the basic models.

■ Photocouplers (PC800 Series) . . . 4-pin DIP or its Multi-channel Type

Model No.	Features	Package				*1Output		Isolation Voltage V_{iso} (Vrms)	Current Transfer Ratio CTR		Response time t_r		Page
		4-pin DIP	8-pin DIP	12-pin DIP	16-pin DIP	SPT	DPT		MIN. (%)	I_F(mA)	TYP. (μs)	R_L(Ω)	
*PC810	High speed under high load resistance	○				○		5,000	60	1	(MAX.50)	1,000	337
PC812	High noise reduction type	○				○		5,000	90	5	(MAX.18)	100	341
PC813	AC input, high noise reduction type (1-channel)	○				○		5,000	20	±1	4	100	345
PC823	AC input, high noise reduction type (2-channel)		○			○		5,000	20	±1	4	100	345
PC843	AC input, high noise reduction type (4-channel)				○	○		5,000	20	±1	4	100	345
*PC814	AC input type (1-channel)	○				○		5,000	20	±1	4	100	350
PC824	AC input type (2-channel)		○			○		5,000	20	±1	4	100	350
PC844	AC input type (4-channel)				○	○		5,000	20	±1	4	100	350
*PC815	High transfer efficiency type (1-channel)	○					○	5,000	600	1	60	100	355
PC825	High transfer efficiency type (2-channel)		○				○	5,000	600	1	60	100	355
PC835	High transfer efficiency type (3-channel)			○			○	5,000	600	1	60	100	355
PC845	High transfer efficiency type (4-channel)				○		○	5,000	600	1	60	100	355
PC816	High collector-emitter voltage, high density mounting type (1-channel)	○				○		5,000	50	5	4	100	359
PC826	High collector-emitter voltage, high density mounting type (2-channel)		○			○		5,000	50	5	4	100	359
PC846	High collector-emitter voltage, high density mounting type (4-channel)				○	○		5,000	50	5	4	100	359
*PC817	General purpose type (1-channel)	○				○		5,000	50	5	4	100	363
PC827	General purpose type (2-channel)		○			○		5,000	50	5	4	100	363
PC837	General purpose type (3-channel)			○		○		5,000	50	5	4	100	363
PC847	General purpose type (4-channel)				○	○		5,000	50	5	4	100	363
*PC818	High speed under high load resistance	○				○		5,000	10	1	7	1,000	367
PC829	Symmetrical terminal configuration type (2-channel)		○			○		5,000	50	5	4	100	384
PC849	Symmetrical terminal configuration type (4-channel)				○	○		5,000	50	5	4	100	384
*PC851	High collector-emitter voltage	○				○		5,000	40	5	4	100	371
PC852	High collector-emitter voltage	○					○	5,000	1,000	1	100	100	375
PC853	High collector-emitter voltage (300V)	○					○	5,000	1,000	1	100	100	375
PC853H	High collector-emitter voltage (350V)	○					○	5,000	1,000	1	100	100	375
PC865	High collector-emitter voltage	○					○	5,000	1,000	1	100	100	380
PC8D52	High collector-emitter voltage (2-channel)		○				○	5,000	1,000	1	100	100	375
PC875	High collector-emitter voltage (2-channel)			○			○	5,000	1,000	1	100	100	380
PC895	High collector-emitter voltage (4-channel)				○		○	5,000	1,000	1	100	100	380
PC8Q52	High collector-emitter voltage (4-channel)				○		○	5,000	1,000	1	100	100	375

*1 SPT: Single transistor output
DPT: Darlington transistor output

* Lead forming type (I type) is available in addition to the basic models.

■ Photocouplers (6N Series) . . General Purpose 6N Series

Model No.	Features	Package	Output		With Base Terminal	Isolation Voltage V_{iso} (Vrms)	Current Transfer Ratio CTR		Propagation Time			Page
		8-pin DIP	Photodiode + Transistor	Photodiode + Darington transistor			MIN. (%)	I_F(mA)	t_{PHL} TYP.(μs)	t_{PLH} TYP.(μs)	R_L(kΩ)	
6N135	High speed, high noise reduction type	○	○		○	2,500	7	16	0.3	0.4	4.1	270
6N136	High speed, high noise reduction type	○	○		○	2,500	19	16	0.3	3.0	1.9	270
6N137	Ultra-high speed response	○	○			2,500	TYP. 700	5.0	0.045	0.045	0.35	275
6N138	High transfer efficiency, high speed type	○		○		2,500	300	1.6	2	7	2.2	280
6N139	High transfer efficiency, high speed type	○		○	○	2,500	400	0.5	5	10	4.7	285

■ OPIC Photocouplers (PC900 Series) . . . . Uses OPIC on Detector Side.

Model No.	Features	Package			Operation		Isolation Voltage V_{iso} (Vrms)	Threshold Input Current		Propagation Time			Page
		6-pin DIP	8-pin DIP	Single-in-line	Low Level with No Input	High Level with No Input		I_{FHL} MAX.(mA)	I_{FLH} MAX.(mA)	t_{PHL} TYP.(μs)	t_{PLH} TYP.(μs)	R_L(Ω)	
PC900V	Digital output type	○				○	5,000	2.0	—	1	2	280	388
PC901V	Digital output type	○			○		5,000	0	2.0	2	1	280	392
PC902	AC input type, capable of forming an integration circuit		○			○	5,000	±0.7	—	7,000	10,500	680	396
PC904	Built-in voltage detector circuit		○		—	—	5,000	—	—	—	—	—	402
PC910	Digital output, high speed response type		○			○	2,500	5.0	—	0.05	0.05	350	408
PC915	Wide band linear output type		○		—	—	5,000	—	—	—	—	—	413
PC917	High speed, high noise reduction type		○			○	2,500	—	—	0.3	0.3	1,900	417
PC918	High speed, high noise reduction type		○			○	2,500	—	—	0.3	0.3	1,900	417
PC9D10	High speed, 2-channel type		○			○	2,500	5.0	—	0.050	0.050	350	432
PC9D17	High speed, high common mode rejection 2-channel type		○			○	2,500	—	—	0.3	0.3	1,900	436
PC920	High output (SIP)			○	○		1,500	—	2.0	3	3	R_{L1}15 R_{L2}18	421
PC921	High output (DIP)		○		○		2,000	—	3.0	2	2	R_{L1} 5 R_{L2}10	426

*PC900V has its lead forming version, PC900VI.

■ Photothyristor Couplers/Phototriac Couplers

Model No.	Features	Package				Repetitive Peak Off-state Voltage V_{DRM}(Vrms)		RMS On-state Current I_T(Arms)		Operating Wave		Minimum Trigger Current I_{FT} MAX.(mA)	Isolation Voltage V_{iso} (Vrms)	Page
		4-pin DIP	4-pin Flat Package	6-pin DIP	8-pin DIP	400	600	0.1	0.2	Half Wave	Full Wave			
S11MD3	High noise reduction type			○		○		○			○	10	2,500	441
**S11MD5V	High isolation voltage type			○		○		○			○	10	5,000	445
S11MD5T	No.5 pin mold type	5-pin DIP				○		○				10	5,000	449
S11MM5	Mini-flat type		○			○		○			○	10	2,500	445
**S12MD1V	High isolation voltage type			○		○			○	○		15	5,000	454
S12MD2	High noise reduction type	○				○			○	○		10	1,500	458
S12MD22	High noise reduction type for telephone sets				○	○			○	○		10	1,500	458
S12MD3	General purpose type				○	○			○		○	15	1,500	454
**S21MD3V	High noise reduction type			○			○	○			○	15	5,000	462
S21MD3TV	No.5 pin mold type	5-pin DIP					○	○				10	5,000	449
**S21MD4V	Built-in zero-cross circuit, high noise reduction type			○			○	○			○	15	5,000	470
S21MD4TV	No.5 pin mold type	5-pin DIP					○	○				10	5,000	449
S21MM3	Mini-flat, high noise reduction type		○				○	○			○	15	2,500	462
S21ME3	Conforms to safety standard in Europe			○			○					7	5,000	466
S21ME3F	Conforms to safety standard in Europe			○			○					7	5,000	466
S21MM4	Built-in zero-cross circuit, mini-flat, high noise reduction type		○				○	○			○	15	2,500	470
S21ME4	Conforms to safety standard in Europe, built-in zero-cross circuit			○			○					7	5,000	466
S21ME4F	Conforms to safety standard in Europe, built-in zero-cross circuit			○			○					7	5,000	466
**S22MD1V	High isolation voltage type			○			○		○	○		10	5,000	474
S22MD2	High isolation voltage type				○		○		○	○		8	5,000	478

**Lead forming type (VI type or W type) is available in addition to the basic models.
*Lead forming type (I type) is available in addition to the basic models.

■ OPIC Photointerrupters (Transmissive Type)

Model No.	Features	Operation		Gap (mm)						Slit Width (mm)			Disk Slit Pitch (mm)		With Connector Terminal	Threshold Input Current		Page
		Low level when shielded	High level when shielded	2	2.4	3	3.2	5	10	0.25	0.5	2	2.5	0.7	1.14		I_{FLH}(mA) MAX.	I_{FHL}(mA) MAX.	
GP1A05	With connector terminal		○					○			○					—	—	—	486
GP1A05HR	With connector terminal	○						○			○					○	—	—	490
GP1A06	2-phase digital output type		○			○							○				—	15	493
GP1A08	Both-sided mounting type	○				○					○						5	—	498
GP1A10	With connector terminal		○					○			○					○	—	—	502
GP1A13R	2-phase digital output encoder type			○											○		—	—	506
GP1A14	5mm gap, PWB direct mounting type	○						○			○						8	—	511
GP1A15	High sensing accuracy, PWB mounting type	○				○				○							10	—	515
GP1A16R	2-phase digital output encoder type			○										○			—	—	519
GP1A17	Wide gap type (10mm)	○							○			○					7	—	523
GP1A18	PWB mounting type	○					○				○						5	—	527
GP1A18LC	PWB mounting type		○				○				○						—	5	531
GP1A18LR	PWB mounting type		○				○				○						—	5	535
GP1A19	Side mounting type	○					○				○						5	—	539
GP1A20	PWB mounting type with cover case	○				○					○						9.5	—	543
GP1A21	Snap-in mounting type with connector terminal		○					○			○					○	—	—	547
GP1A22HR	With connector terminal	○						○			○					○	—	—	490
GP1A22LC	With connector terminal							○			○					○	—	—	486
GP1A23LC	With connector terminal		○					○			○					○	—	—	486
GP1A25LC	With connector terminal		○					○			○					○	—	—	486
GP1A26LC	With connector terminal							○			○					○	—	—	502
GP1A27LC	Snap-in mounting type with connector terminal		○					○			○					○	—	—	547
GP1A30R	2-phase digital output encoder type, plastic disk available				○									○			—	—	551
GP1A31LC	With connector terminal		○					○			○					○	—	—	555
GP1A33R	2-phase digital output encoder type, plastic disk available				○										○		—	—	558
GP1A34LC	Snap-in mounting type with connector terminal		○					○			○					○	—	—	563
GP1A35R	2-phase digital output encoder type, moire stripe application													0.22			—	—	567
GP1A40	With lever type actuator & connector															○	—	—	572
GP1A50HR	Both-sided mounting type	○				○					○						5	—	575
GP1A51HR	Side mounting type	○				○					○						5	—	575
GP1A52HR	PWB mounting type	○				○					○						5	—	575
GP1A52LR	PWB mounting type		○			○					○						—	5	579
GP1A53HR	PWB mounting type	○						○			○						8	—	583
GP1A57HR	With positioning pin	○							○								5	—	587

■ OPIC Photointerrupters (Reflective Type)

Model No.	Features	Detecting Distance (mm)	Operating Supply Voltage V_{CC} (V)	Visible Light Cut-off	Low Level Output Voltage Vol (V) Typ.	Page
GP2A10	Long focal distance	2~7	4.5~5.5		0.2	732
GP2A11	Light modulation type	2~5	4.5~5.5		0.2	735
GP2A12F	Long focal distance	4~5	4.5~5.5	○	0.2	739

■ Photointerrupters (Transmissive Type)

Model No.	Features	Gap (mm)								Slit width (mm)					With Connector	Visible Light Cut-off	*1 Output		Current Transfer Ratio CTR		Page
		0.9	2	3	3.5	4.2	5	10	13.2	0.15	0.25	0.5	0.8	2.0			SPT	DPT	MIN. (%)	I_F(mA)	
GP1S01	General purpose type			○										○			○		10	20	591
GP1S01F	General purpose, visible light cut-off type			○										○		○	○		8	20	591
GP1S05	5mm gap, PWB mounting type						○					○					○		2.5	20	595
GP1S06	High sensing accuracy, PWB mounting type			○							○						○		0.5	20	599
GP1S07	Compact, PWB mounting type	○											○				○		4.3	1.5	603
GP1S09	Snap-in mounting type with connector terminal						○						○		○		○		2.5	20	607
GP1S10	PWB mounting type with cover case			○								○					○		2	20	612
GP1S11	Linear output, PWB mounting type			○													○		11.5	20	616
GP1S12	PWB mounting type with positioning pin				○									○			○		10	10	620
GP1S17	Compact, PWB mounting type		○										○				○		1	3	624
GP1S18	Compact, PWB mounting type	○									0.3						○		1.6	1.5	628
GP1S20	With positioning pin, PWB mounting	1.1									0.3						○		1.6	1.5	632
GP1S21	With mounting hole	1.2											○				○		1.8	1.5	636
GP1S22	With mounting hole	1.2									0.3						○		2	5	640
GP1S23	With mounting hole		○								0.3						○		0.8	5	644
GP1S40	With lever type actuator & connector														○		○		2.5	20	648
GP1S41	With lever type actuator & connector														○		○		2.5	20	653
GP1S50	Both-sided mounting type			○								○					○		2.5	20	657
GP1S51	Side mounting type			○								○					○		2.5	20	657
GP1S52	PWB mounting type			○								○					○		2.5	20	657
GP1S53	PWB mounting type						○					○					○		2.5	20	661
GP1S54	PWB mounting type			○								○					○		2.5	20	665
GP1S55	With positioning pin		○							○							○		3	20	669
GP1S56	With positioning pin PWB mounting type		○							○							○		20	20	673
GP1S560	With positioning pin PWB mounting type		○							○							○		1	20	677
GP1S58	With positioning pin PWB mounting type						○					○					○		2.5	20	681
GP1L01	High sensitivity type			○										○				○	300	1	685
GP1L01F	High sensitivity, visible light cut-off type			○										○		○		○	250	1	685
GP1L02	High sensitivity, side mounting type					○								○				○	20	10	689
GP1L03	Wide gap type (10mm)							○						○				○	100	1	692
GP1L06	High sensitivity, 5mm gap, PWB mounting type						○					○						○	30	1	696
GP1L07	Compact and light, high sensitivity, PWB mounting type	○											○					○	50	1	700
GP1L12	High sensitivity, PWB mounting type with positioning pin				○									○				○	300	1	704
GP1L21	With mounting hole, PWB mounting type	1.2											○					○	40	1	708
GP1L22	With mounting hole, PWB mounting type	1.2									0.3							○	20	1	712
GP1L50	High sensitivity, Both-sided mounting type			○								○						○	50	1	716
GP1L51	High sensitivity, Side mounting type			○								○						○	50	1	716
GP1L52	High sensitivity, PWB mounting type			○								○						○	50	1	716
GP1L53	High sensitivity, PWB mounting type						○					○						○	30	1	720
GP1L54	High sensitivity, PWB mounting type			○								○						○	50	1	724
GP1L55	High sensitivity, PWB mounting type		○							○								○	30	2	728

*1 SPT: Single transistor output
DPT: Darlington transistor output

■ Photointerrupters (Reflective Type)

Model No.	Features	Package			Focal Distance (mm)				Visible Light Cut-off	*1 Output		Current transfer Ratio CTR		Page
		Case Type	DIP Mold	Snap-in Type	1	3	4	5		SPT	DPT	MIN. (%)	I_F(mA)	
GP2S01	General purpose type	○						○		○		1	20	742
GP2S01F	General purpose type	○						○	○	○		1	20	742
GP2S03	Long focal distance type	○						○	○	○		0.8	20	746
GP2S04	Compact, dual-in-line package		○		○				○	○		0.5	4	749
GP2S05	Compact, long focal distance type			○			○		○	○		1.4	20	754
GP2S06	Compact, flat package type		○						○	○		0.5	4	749
GP2S07	Compact, mini-flat package type		○						○	○		0.5	4	749
GP2S09	Compact DIP type with long lead		○						○	○		0.5	4	749
GP2S10	Compact, short lead flat package		○		○				○	○		0.5	4	749
GP2S15	Compact DIP type with long lead		○				○		○	○		0.5	20	754
GP2L01	High sensitivity type	○						○			○	30	10	758
GP2L01F	High sensitivity type	○						○	○		○	25	10	758
GP2L04	High sensitivity, compact DIP type		○		○				○		○	12.5	4	762
GP2L06	High sensitivity, compact flat package type		○		○				○		○	12.5	4	762
GP2L09	High sensitivity, compact DIP type with long lead		○		○				○		○	12.5	4	762
GP2L20L/R	Prism system conformable type, DAT tape-end detection	○									○	5	20	767
GP2TD02	Optical tilt sensor		○					11.8			○	—	—	771

*1 SPT : Single transistor output
DPT : Darlington transistor output

1

■ Solid State Relays

Model No.	Features	Package			Repetitive Peak Off-state Voltage V_{DRM}(Vrms)		RMS On-state Current I_T (Arms)						Zero-cross Circuit	Snubber circuit	Isolation Voltage Viso (Vrms)	Minimum Trigger Current I_{FT} (mA) MAX.	Page
		SIP	DIP	Other package	400	600	1.2	1.5	2	12	16	Multi-output					
S101D01	100V lines		○		○		○								5,000	10	776
S201D01	200V lines		○			○	○								5,000	10	776
S101D02	100V lines, built-in zero-cross circuit		○		○		○						○		5,000	10	776
S201D02	200V lines, built-in zero-cross circuit		○			○	○						○		5,000	10	776
S202D81	200V lines, for controlling 2A (8-channel)			○		○			○						2,500	—	796
S201DX1	200V lines, for controlling 1A (16-channel)			○		○	(1)								2,500	—	796
S112P11	100V lines, compact, built-in zero-cross & snubber circuits			○	○					○			○	○	2,500	—	784
S212P11	200V lines, compact, built-in zero-cross & snubber circuits			○		○				○			○	○	4,000	—	784
S116P11	100V lines, compact, built-in zero-cross & snubber circuits			○	○						○		○	○	2,500	—	784
S216P11	200V lines, compact, built-in zero-cross & snubber circuits			○		○					○		○	○	4,000	—	784
S116P21	100V lines, compact, 2-output, built-in zero-cross & snubber circuits			○	○							16,3	○	○	2,000	—	787
S216P21	200V lines, compact, 2-output, built-in zero-cross & snubber circuits			○		○						16,3	○	○	4,000	—	787
S116P41	100V lines, 4-output built-in snubber circuit			○	○							4-ch. (16,5 / 3,3)		○	1,500	—	790
S216P41	200V lines, 4-output built-in snubber circuit			○		○						4-ch. (16,3 / 3,3)		○	4,000	—	790
S116P42	100V lines, compact, 4-output CH1 : built- in zero-cross cirucuit			○	○							4-ch. (16,3 / 3,3)	○ (ch1)		2,000	—	793
S216P42	200V lines, compact, 4-output CH1 : built-in zero-cross circuit			○		○						4-ch. (16,3 / 3,3)	○ (ch1)		4,000	—	793
S101S01	100V lines, compact, high rush current resistivity	○			○			○							4,000	15	780
S201S01	200V lines, compact, high rush current resistivity	○				○		○							4,000	15	780
S101S02	100V lines, compact, high rush current resistivity	○			○			○					○		4,000	15	780
S201S02	200V lines, compact, high rush current resistivity, built-in zero-cross circuit	○				○		○					○		4,000	15	780
S101S03	100V lines, compact, built-in input resistor, high rush current resistivity	○			○			○							4,000	15	780
S201S03	200V lines, compact, built-in input resistor, high rush current resistivity	○				○		○							4,000	15	780
S101S04	100V lines, compact, built-in input resistor, high rush current resistivity, built-in zero-cross circuit	○			○			○					○		4,000	15	780
S201S04	200V lines, compact, built-in input resistor, high rush current resistivity, built-in zero-cross circuit	○				○		○					○		4,000	15	780

Table of Models with Safety Standard Approval

■ Photocouplers

As of July 25, 1988

Model No.	UL	TÜV	VDE	BS	SEMKO	DEMKO	EI FEMKO	NOTE
PC100	○	—	○*1	○▲1	○☆1	○◆1	○★1	
PC101	○	—	○*1	○▲1	○☆2	○◆1	○★2	
PC110	○	—	○*2	○▲2	○☆3	○◆1	○★3	Double
PC111	○	—	○*2	○▲2	○☆4	○◆1	○★4	protection
PC112	○	—	○*2	○▲2	○☆5	○◆1	○★5	approved
PC113	○	—	○*2	○▲2	○☆6	○◆1	○★6	
PC511	○	○※1	—	—	—	—	—	
PC619	○	—	—	—	—	—	—	
PC702V	○	○※8	—	—	—	—	—	PC702VI Included
PC703V	○	○※8	—	—	—	—	—	PC703VI Included
PC713V	○	○※2	—	—	—	—	—	PC713VI Included
PC714V	○	○※2	—	—	—	—	—	PC714VI Included
PC715V	○	○※2	—	—	—	—	—	PC715VI Included
PC716V	○	○※2	—	—	—	—	—	PC716VI Included
PC723V	○	○	—	—	—	—	—	PC723VI Included
PC724V	△	—	—	—	—	—	—	
PC725V	△	△	—	—	—	—	—	PC725W Included
PC733	○	—	—	—	—	—	—	PC733I Included
PC733H	○	—	—	—	—	—	—	
PC810	○	—	—	—	—	—	—	PC810I Included
PC813	○	—	—	—	—	—	—	
PC814	○	—	—	—	—	—	—	PC814I Included
PC815	○	○※3	—	—	—	—	—	PC815I Included
PC816	○	—	—	—	—	—	—	
PC817	○	○※4	—	—	—	—	—	PC817I Included
PC818	○	○※5	—	—	—	—	—	PC818I Included
PC823	○	—	—	—	—	—	—	
PC824	○	—	—	—	—	—	—	
PC825	○	○※3	—	—	—	—	—	
PC826	○	—	—	—	—	—	—	
PC827	○	○※4	—	—	—	—	—	
PC829	○	○※4	—	—	—	—	—	
PC835	○	○※3	—	—	—	—	—	
PC837	○	○※4	—	—	—	—	—	
PC843	○	—	—	—	—	—	—	
PC844	○	—	—	—	—	—	—	
PC845	○	○※3	—	—	—	—	—	
PC846	○	—	—	—	—	—	—	
PC847	○	○※4	—	—	—	—	—	
PC849	○	○※7	—	—	—	—	—	
PC851	○	—	—	—	—	—	—	
PC865	○	—	—	—	—	—	—	
PC875	○	—	—	—	—	—	—	

○ : Approved　△ : Under preparation

Model No.	UL	TÜV	VDE	BS	SEMKO	DEMKO	EI FEMKO	NOTE
PC895	○	—	—	—	—	—	—	
PC900V	○	○※6	—	—	—	—	—	PC900VI Included
PC901V	△	—	—	—	—	—	—	
PC902	○	—	—	—	—	—	—	
PC904	○	—	—	—	—	—	—	
PC910	○	—	—	—	—	—	—	
PC9D10	○	—	—	—	—	—	—	
PC917	○	—	—	—	—	—	—	
PC9D17	○	—	—	—	—	—	—	
PC918	○	—	—	—	—	—	—	
PC920	○	—	—	—	—	—	—	
PC921	○	—	—	—	—	—	—	
PC4N25V	○	○※9	—	—	—	—	—	PC4N25VI Included
PC4N26V	○	○※10	—	—	—	—	—	PC4N26VI Included
PC4N27V	○	○※10	—	—	—	—	—	PC4N27VI Included
PC4N28V	○	—	—	—	—	—	—	PC4N28VI Included
PC4N29V	○	○※11	—	—	—	—	—	PC4N29VI Included
PC4N30V	○	○※12	—	—	—	—	—	PC4N30VI Included
PC4N32V	○	○※11	—	—	—	—	—	PC4N32VI Included
PC4N33V	○	○※12	—	—	—	—	—	PC4N33VI Included
PC4N35V	○	○※9	—	—	—	—	—	PC4N35VI Included
PC4N36V	○	○※9	—	—	—	—	—	PC4N36VI Included
PC4N37V	○	○※10	—	—	—	—	—	PC4N37VI Included
6N135	○	—	—	—	—	—	—	PC6N135
6N136	○	—	—	—	—	—	—	PC6N136
6N137	○	—	—	—	—	—	—	PC6N139
6N138	○	—	—	—	—	—	—	UL Standard
6N139	○	—	—	—	—	—	—	recognized.

○ : Approved △ : Under preparation

UL File No. E64380

TÜV Licence No. ※1 : R20044 ※2 : 20036 ※3 : R40001 ※4 : R20042 ※5 : R40002 ※6 : R20043 ※7 : R40006 ※8 : R40181 ※9 : R40182 ※10 : R40183 ※11 : R40184 ※12 : R40185 ※13 : R40003 ※14 : R50095 ※15 : R60317

VDE Licence No. ＊1 : 53181 ＊2 : 53182 ＊3 : 53183 BS Certificate No. ▲1 : 6795 ▲2 : 6690

SEMKO Licence No. ☆1 : 8710014 ☆2 : 8710015 ☆3 : 8705118 ☆4 : 8705119 ☆5 : 8705120 ☆6 : 8705121 ☆7 : 8705122 ☆8 : 8705123

EI FEMKO Licence No. ★1 : 099445-01 ★2 : 099446-01 ★3 : 099447-01 ★4 : 099448-01 ★5 : 099449-01 ★6 : 099450-01 ★7 : 099443-01 ★8 : 099444-01

DEMKO Licence No. ◆1 : 37150 ◆2 : 37123

■ Photothyristor Couplers · Phototriac Couplers

Model No.	UL	TÜV	VDE	BS	SEMKO	DEMKO	EI FEMKO	NOTE
S11MD3	○	—	—	—	—	—	—	
S11MD5V	○	—	—	—	—	—	—	Pin No. 5 cut type. S11MD5VI Included
S11MD5T	○	—	—	—	—	—	—	
S12MD1V	△	—	—	—	—	—	—	S12MD1VI Included
S12MD2	○	—	—	—	—	—	—	
S12MD2 (2ch.)	○	—	—	—	—	—	—	S12MD22
S12MD3	○	—	—	—	—	—	—	
S21MD3V	○	○※14	—	—	—	—	—	S21MD3W Included
S21MD3T	○	○※14	—	—	—	—	—	
S21MD4V	○	○※14	—	—	—	—	—	S21MD4W Included
S21MD4TV	△	△	—	—	—	—	—	
S22MD1V	△	△	—	—	—	—	—	S22MD1VI Included
S21ME3	○	—	○＊3	○▲2	○☆7	○◆2	○★7	S21ME3F/I Included
S21ME4	○	—	○＊3	○▲2	○☆8	○◆2	○★8	S21ME4F/I Included
S21MM3	—	○※15	—	—	—	—	—	
S21MM4	—	○※15	—	—	—	—	—	

○ : Approved　△ : Under preparation

UL File No. E64380

TÜV Licence No. ※1 : R20044　※2 : 20036　※3 : R40001　※4 : R20042　※5 : R40002　※6 : R20043　※7 : R40006　※8 : R40181　※9 : R40182　※10 : R40183　※11 : R40184　※12 : R40185　※13 : R40003　※14 : R50095　※15 : R60317

VDE Licence No. ＊1 : 53181　＊2 : 53182　＊3 : 53183　BS Certificate No. ▲1 : 6795　▲2 : 6690

SEMKO Licence No.　☆1 : 8710014　☆2 : 8710015　☆3 : 8705118　☆4 : 8705119　☆5 : 8705120　☆6 : 8705121　☆7 : 8705122　☆8 : 8705123

EI FEMKO Licence No.　★1 : 099445-01　★2 : 099446-01　★3 : 099447-01　★4 : 099448-01　★5 : 099449-01　★6 : 099450-01　★7 : 099443-01　★8 : 099444-01

DEMKO Licence No.　◆1 : 37150　◆2 : 37123

■ Solid State Relays

Model No.	UL	TÜV	CSA	NOTE
S101S01	○※1	—	○☆1	
S101S02	○※1	—	○☆1	
S101S03	○※1	—	○☆1	
S101S04	○※1	—	○☆1	
S201S01	—	○＊2	—	
S112P11	○※1	—	○☆2	
S116P11	○※1	—	○☆2	
S212P11	○※1	○＊1	○☆2	
S216P11	○※1	○＊1	○☆2	
S116P21	○※1	—	○☆1	
S202D81	○※1	—	○☆2	
S201DX1	○※1	—	○☆2	

○ : Approved

UL File No. ※1 : E94758
TÜV Licence No. ＊1 : R75164 ＊2 : R75165
CSA Licence No. ☆1 : 63705 ☆2 : 68813

Explanations

2

2-1 General Description of Optoelectronic Devices

2-1-1 Infrared Light Emitting Diode (LED)

(1) Operating principle

The infrared LED utilizes the PN junction of gallium arsenide (GaAs) crystals.

When no voltage is applied to the PN junction of an infrared LED, the junction is placed in a thermal equilibrium, as shown in Fig. 1 (a), wherein the Fermi level of the P layer matches that of the N layer, with the height of the potential barrier set at V_D.

Once a forward voltage V is applied to the junction, the height of the potential barrier is reduced to V_D-V (see Fig. 1 (b)), and holes and electrons are injected into the N and P layers, respectively. As a result, both layers have a higher carrier concentration than that at the time of thermal equilibrium. And carrier recombination occurs as the PN junction tries to return to stable thermal equilibrium. The energy difference occurring before and after carrier recombination in emitted as an infrared light.

Infrared LEDs use GaAs crystals for the following reasons:

① Silicon (Si) or germanium (Ge) forms an indirect transition type semiconductor in which carrier recombination is accompanied with thermal vibration of the crystal lattice. In contrast, the GaAs semiconductor has a direct transition band structure with only light emitting in which transition is accompanied with no thermal vibration. Hence light emission efficiency is relatively high.

② The light emission spectrum of the GaAs infrared LED is similar to that of the Si light detecting elements.

In general, the optical output (radiant flux: Φ_e) resulting from a forward current supplied to a PN junction is given by the following formula:

$$\Phi_e = \frac{1.24}{\lambda} \eta_e I_F$$

η_e: External quantum efficiency

The external quantum efficiency (η_e) is approximately 1% for the diffusion type GaAs, 2 to 5% for the liquid phase epitaxial GaAs, 0.1% for the gallium arsenide phosphor (GaAsP), 1 to 3% for the gallium phosphor (GaP) red, and 0.02 to 0.05% for the GaP green. This reveals that the liquid phase epitaxial GaAs LED produces the largest optical output.

The peak wavelength λ of the optical output depends on the energy released at the time of carrier recombination, as follows:

$$E_g \simeq \Delta E = h\nu$$

$$\nu = \frac{c}{\lambda}$$

E_g: Energy band gap
ΔE: Energy difference occurring as a result of carrier recombination
h: Planck's constant
ν: Frequency of light
c: Velocity of light

Above formulas give the peak wavelength (λ) as follows:

$$\lambda = \frac{hc}{E_g} \simeq \frac{1.24}{E_g} \times 10^3 \quad \text{(nm)}$$

From this formula we know that the peak wavelength of the GaAs LED is approximately 950 nm. The wavelength characteristics of the GaAs infrared LED and Si photodiode are shown in Fig. 2.

(2) Appearance and structures

The infrared LED can have the following three packages.

(a) Can package

The LED chip is mounted on a metal stem and is sealed in a cap that has a window. The emission light has a beam angle depending on the lens-shaped cap window. This type of package is superior to other types of packages in terms of moisture-, heat- and corrosion-proof performance, and is suited for applications in severe environments.

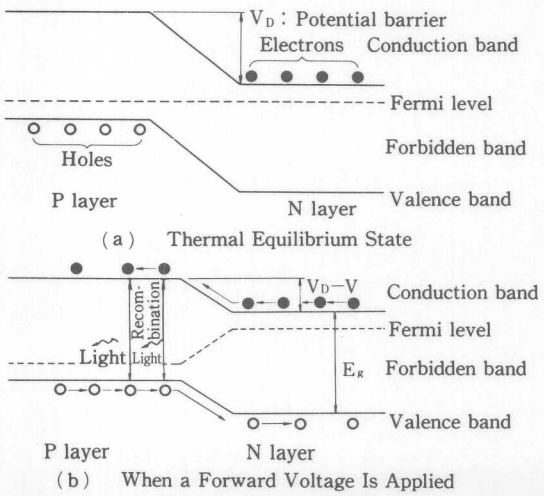


Fig. 1 Band model of PN Junction

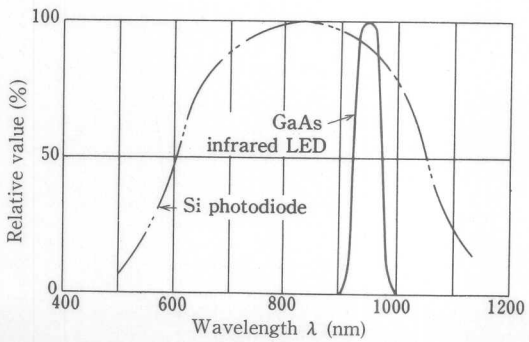


Fig. 2 Wavelength Characteristics

(b) Resin stem package

The chip is mounted on a resin stem and is coated with transparent resin.

(c) Resin mold package

The chip is mounted on a lead frame and is molded in transparent resin. The emission light can have a variety of directions or beam angles depending on the lens-shaped resin.

Fig. 3 shows package structures of infrared LEDs.

(3) Electro-optical characteristics

① Forward current versus forward voltage

The current versus voltage response of the GaAs infrared LED is similar to that of ordinary silicon diodes. A typical example is shown in Fig. 4

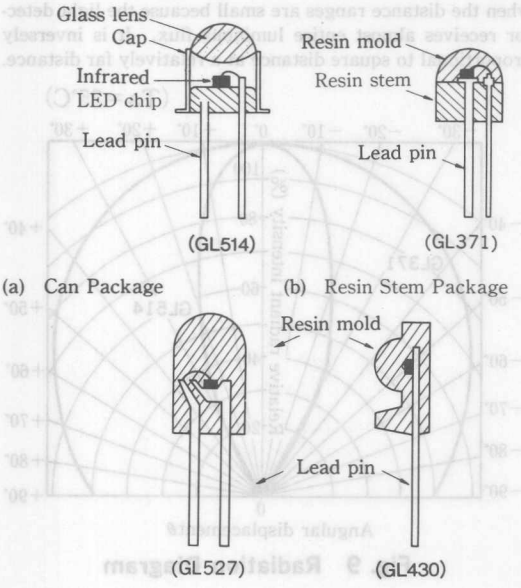


Fig. 3 Package Structures of Infrared LED

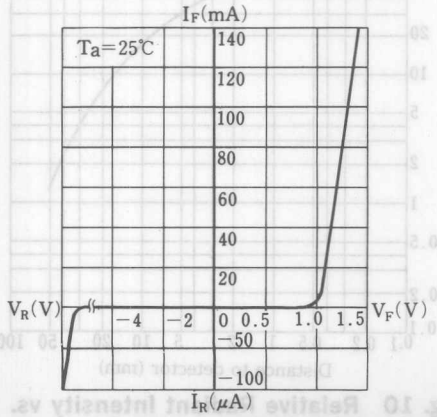


Fig. 4 Current vs. Voltage (GL514)

When a forward voltage is applied to an LED, a forward current begins flowing at a certain voltage. This voltage is called a forward threshold voltage. The GaAs infrared LED has a threshold voltage of approximately 1.0V, which is larger than that of general silicon diodes (approx. 0.6V).

The GaAs infrared LED has a relatively small reverse breakdown voltage (absolute maximum rating: 3 to 6V) as compared with that of silicon diodes (more than 30V). Hence, care must be taken to avoid application of reverse voltage exceeding this maximum rating.

Fig. 5 shows the forward current versus forward voltage response of a GaAs infrared LED using a temperature parameter. The GaAs infrared LED has a forward voltage temperature coefficient of approximately −1.9mV/°C, which is slightly smaller than that of silicon diodes (−2.3 mV/°C). The forward voltage drops by approximately 0.19 V per temperature rise of 100°C.

② Radiant flux versus forward current

The total optical energy irradiated from an infrared LED is referred to as radiant flux, represented in watts.

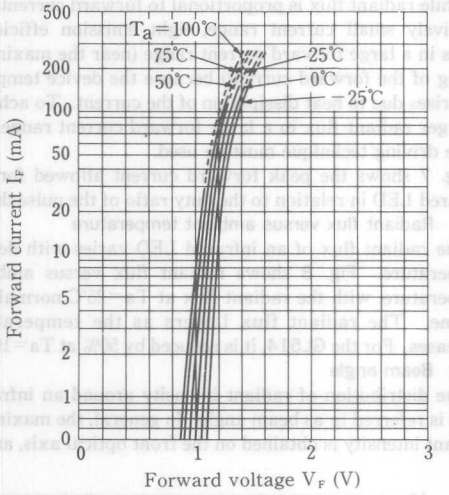


Fig. 5 Forward Current vs. Forward Voltage (GL514)

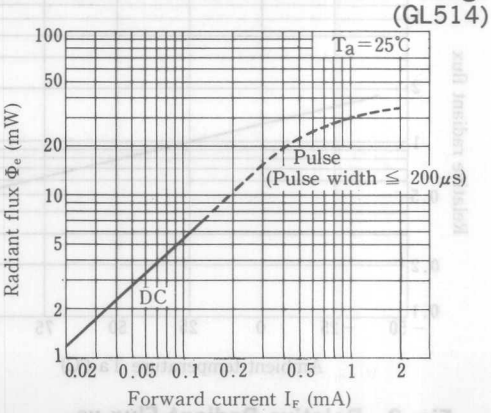


Fig. 6 Radiant Flux vs. Forward Current (GL514)

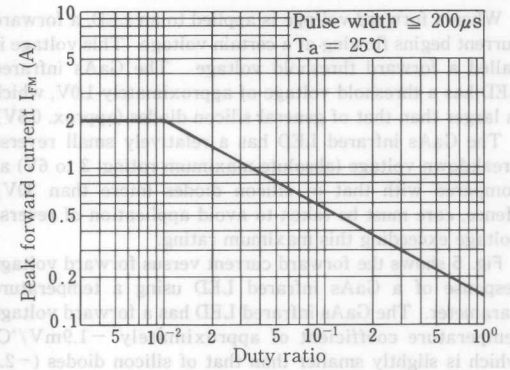


Fig. 7 Peak Forward Current vs. Duty Ratio (GL514)

Fig. 6 shows a typical example of radiant flux versus forward current response.

While radiant flux is proportional to forward current in a relatively small current range, light emission efficiency drops in a large forward current range (near the maximum rating of the forward current) because the device temperature rises due to heat dissipation of the current. To achieve a larger radiant flux in a large forward current range, the pulse driving technique must be used.

Fig. 7 shows the peak forward current allowed for the infrared LED in relation to the duty ratio of the pulse drive.

③ Radiant flux versus ambient temperature

The radiant flux of an infrared LED varies with device temperature. Fig. 8 shows radiant flux versus ambient temperature, with the radiant flux at Ta=25°C normalized to one. The radiant flux lowers as the temperature increases. For the GL514, it is reduced by 50% at Ta=100°C.

④ Beam angle

The distribution of radiant intensity around an infrared LED is referred to as beam angle. In general, the maximum radiant intensity is obtained on the front optical axis, and is reduced as the angle to the optical axis increases. The range of the optical angle, within which the radiant intensity is no less than 50% of the maximum available value, is referred to as the half intensity angle, which is used as a guideline to identify the beam angle response curve.

A typical example of radiation diagram is shown in Fig. 9. The figure tells us that the GL371 has a half intensity angle of ±90 degrees. We know from this figure that the GL371 has a wide beam angle.

⑤ Radiant intensity versus distance

The radiant intensity of an infrared LED has a response along its optical axis as represented by Fig. 10.

Radiant intensity is, in general, inversely proportional to square distance. For a device with narrow beam angle, however, the radiant intensity is far less dependent on distance when the distance ranges are small because the light detector receives almost entire luminous flux. It is inversely proportional to square distance at a relatively far distance.

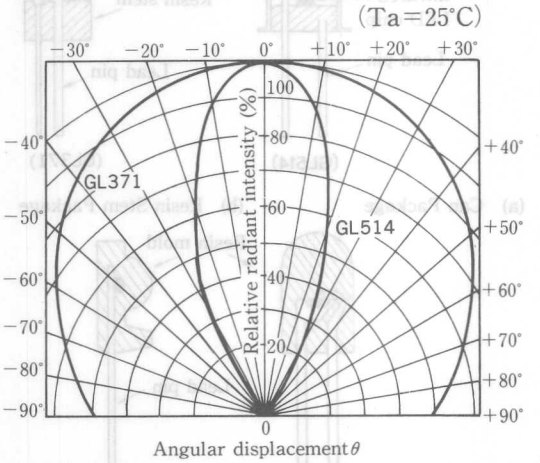


Fig. 9 Radiation Diagram

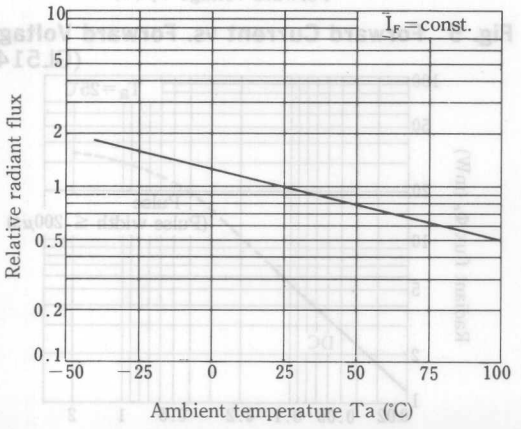


Fig. 8 Relative Radiant Flux vs. Ambient Temperature (GL514)

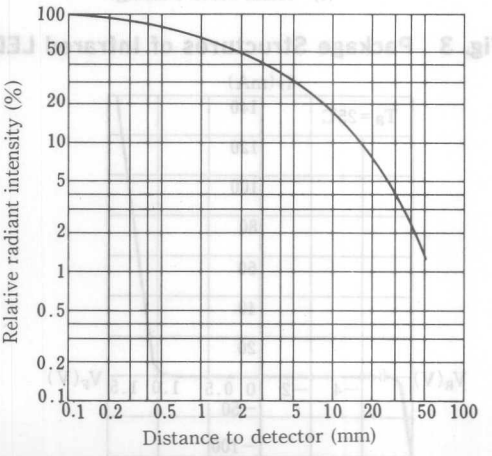


Fig. 10 Relative Radiant Intensity vs. Distance (GL514)

2-1-2 Photodiode

(1) Operating principle

When the PN junction of a silicon (Si) diode is exposed to light, it produces electron-hole pairs in the silicon crystal, as shown in Fig. 11. If the incident light has a greater energy than the silicon's energy band gap (E_g), the electrons and holes diffuse along the concentration gradient in the PN junction. When they reach the depletion layer, they are accelerated by an electric field, and electrons and holes diffuse into the N and P layers, respectively. As a result, if the both edges of PN junction are open, an electromotive force (V_{OC}) is produced across the PN junction, and a current (I_P) flows through the junction in reverse direction if a load is connected across it.

It is the electrons and holes generated in the colse vicinity of the PN junction surface that efficiently cause the photocurrent output. Those generated away from the PN junction recombine and disappear before reaching the depletion layer, hence do not serve the photocurrent.

To improve sensitivity to long wavelength light, a deep junction is needed, as shown is Fig. 12. To make the device sensitive to short wavelength light, a junction must be formed near the silicon surface.

Since silicon has an energy band gap (E_g) of 1.12eV, the upper limit of light wavelength that contributes to photocurrent output of the silicon photodiode is given by the following formula:

$$\lambda = \frac{hc}{E_g} = \frac{1.24}{E_g} \simeq 1{,}100(\text{nm})$$

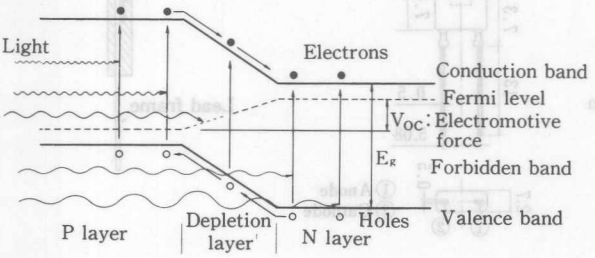


Fig. 11 Band Model of Photodiode

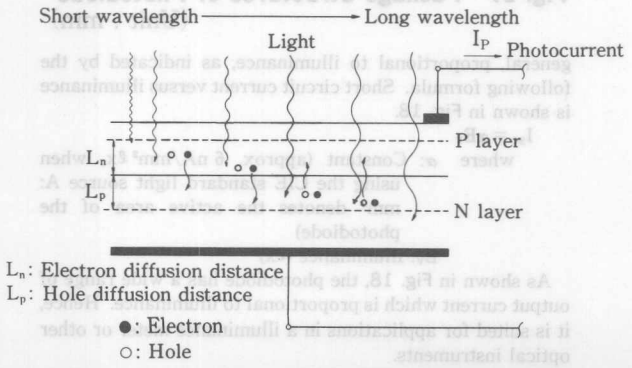


Fig. 12 Operating Principle of Photodiode

Incident light with a wevelength of more than 1,100 nm makes almost no contribution to photocurrent output. Fig. 13 shows the spectral sensitivity of a typical photodiode.

An equivalent circuit of an ideal photodiode is shown in Fig. 14. It is a parallel network of a constant current, source which derives from incident light, an ideal diode, and a junction capacitance C_j. We find the following relationship between the current and voltage of this ideal photodiode:

$$I = I_P - I_D$$

$$I_P = \beta q R_T$$

$$I_D = I_S \left(\exp \frac{qv}{KT} - 1\right)$$

I: Output current
I_S: Diode's saturation current
q: Electron charge
k: Boltzmann's constant
T: Absolute temperature
β: Electron-hole pair absorptance
R_T: Number of effective photons absorbed by the device

The open circuit voltage V_{OC} and short circuit current I_{SC} can be obtained by putting I=0 or V=0 in the previous voltage-current equation for the photodiode, as follows:

$$V_{OC} = \frac{KT}{q} \ln \left(\frac{I_P}{I_S} + 1\right)$$

$$I_{SC} = I_P = \beta q R_T$$

Fig. 15 shows the current versus voltage responses of a photodiode obtained with incident light turned on or off. Fig. 16 shows the current versus voltage responses obtained with incident light intensity used as a parameter.

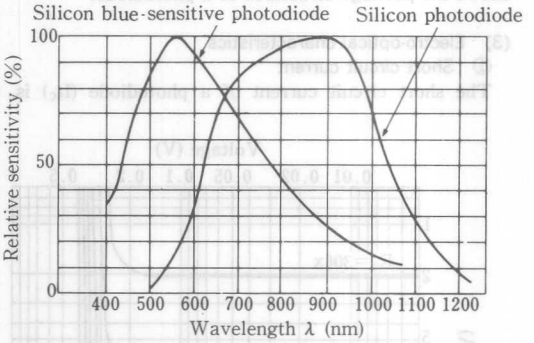


Fig. 13 Spectral Sensitivity

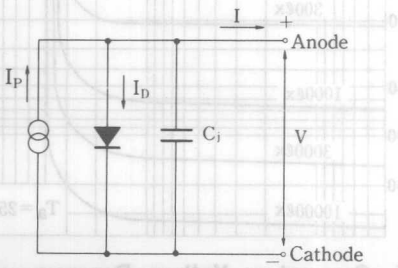


Fig. 14 Equivalent Circuit of Photodiode

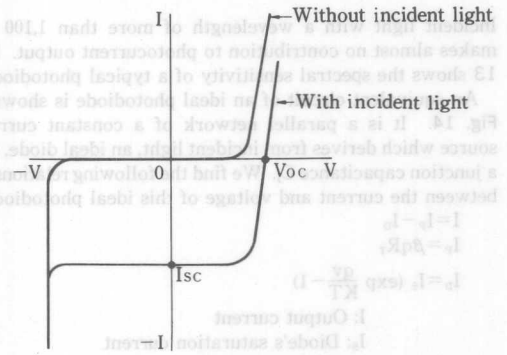


Fig. 15 Current vs. Voltage

(2) Appearance and structures

Photodiodes are available in the following three typical packages:

(a) Can package

The diode chip is mounted on a metallic stem and is sealed with a cap that has a window (TO-5 or TO-8).

(b) Ceramic stem package

The chip is mounted on a ceramic stem and is coated with resin.

(c) Resin mold package

The chip is mounted on a lead frame and molded with resin. Some diodes use molding resin which is transparent only to infrared light and thus shuts off visible light. Fig. 17 shows the package structures of a photodiode.

(3) Electro-optical characteristics

① Short circuit current

The short circuit current of a photodiode (I_{SC}) is, in general, proportional to illuminance, as indicated by the following formula. Short circuit current versus illuminance is shown in Fig. 18.

$I_{SC} = \alpha E_V$

where α: Constant (approx. 6 nA/mm² ℓx, when using the CIE standard light source A: mm² denotes the active area of the photodiode)

E_V: Illuminance (ℓx)

As shown in Fig. 18, the photodiode has a wide range of output current which is proportional to illuminance. Hence, it is suited for applications in a illuminance meter or other optical instruments.

The temperature characteristics of short circuit current is approximately +0.2%/°C when using light source A.

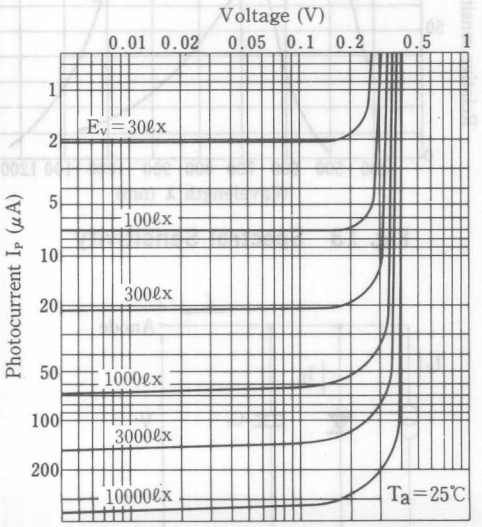


Fig. 16 Current vs. Voltage Response with Illuminance Parameter (BS112)

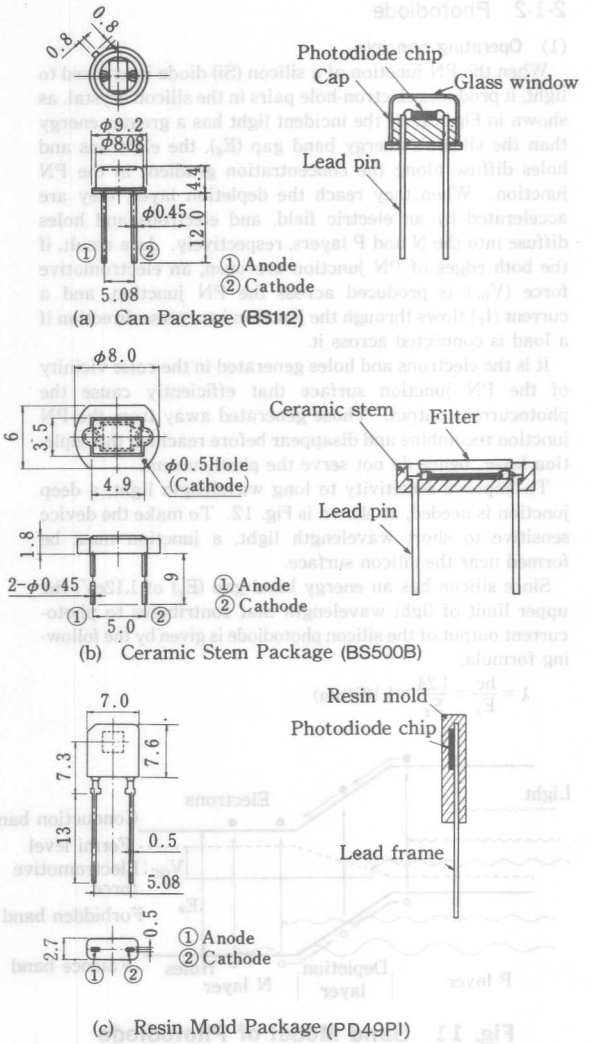


Fig. 17 Package Structures of Photodiode (Unit : mm)

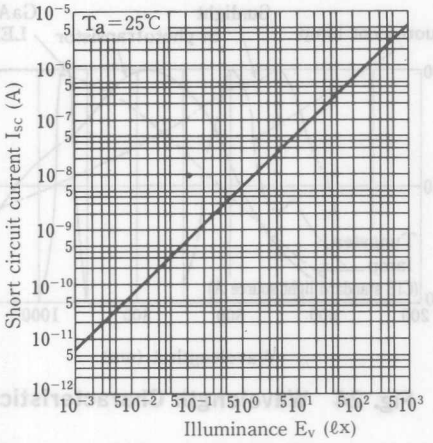


Fig. 18 Short Circuit Current vs. Illuminance (BS500B)

② Open circuit voltage

As known from the previous formula of V_{oc}, open circuit voltage is obtained by logarithmic compression of illuminance. Its temperature characteristic is approximately −2.5mV/℃.

③ Dark current

When there is no incident light, a reverse leak current passes through the photodide. This leak current is called dark current.

As seen in Fig. 20, dark current increases as the reverse voltage or ambient temperature increases. Since dark current defines the lower sensitivity threshold, it must be reduced as much as possible. Photodiodes used in photometers of cameras exhibit a dark current of as low as 10^{-12} A at a normal tempeature (Ta=25℃).

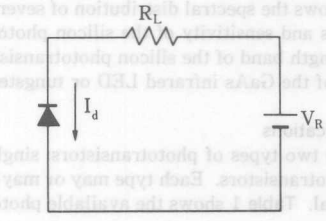


Fig. 19 Dark Current of Photodiode

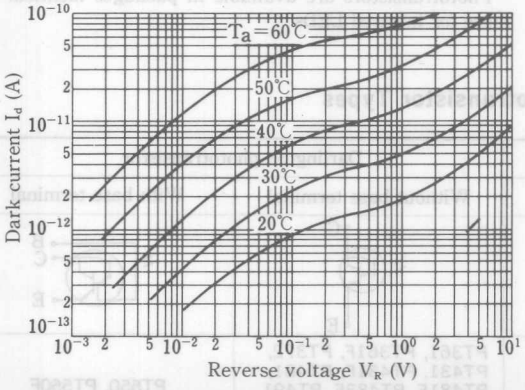


Fig. 20 Dark Current vs. Reverse Voltage (BS500B)

④ Response time

Photodiode's response speed depends chiefly on the following factors:

(a) CR constant of the photodiode

(b) Carrier transition time

The response speed, which depends on CR constant, is given by the following formula using the junction capacitance C_j of the photodiode and load resistance R_L:

$$t_r,\ t_f \simeq 2.2 C_j \cdot R_L$$

The junction capacitance C_j depends on the reverse voltage V_R applied to the photodiode, as follows:

$$C_j = A\,(V_D - V_R)^{-Z}$$

where A: Constant

V_D: Diffusion potential (0.5 to 0.9V)

V_R: Reverse voltage (negative value)

Z: 1/2 to 1/3

The C_j is reduced as the reverse voltage is increased. This means that a higher response speed can be obtained by applying a reverse voltage to the photodiode.

Be careful using the photodiode in low illuminance range because the dark current increases by the application of reverse voltage.

The carrier transition time refers to the time required for the carriers produced at PN junction of a photodiode to diffuse along the concentration gradient and reach the depletion layer. When the CR constant is relatively small, transition time is an important factor that affects the response speed. Fig. 21 shows the response time versus load resistance of a photodiode. The PIN photodiode is recommended for applications that require high response speed of light detection.

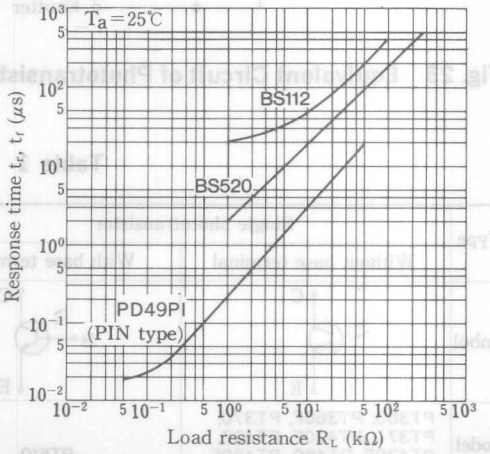


Fig. 21 Response Time vs. Load Resistance

2-1-3 Phototransistor

(1) Operating principle

Construction of phototransistor is basically equivalent to ordinary NPN transistors, with the exception that the former has a larger P-type base area to obtain a large collector current with base-collector junction, as shown in Fig. 22.

The equivalent circuit of a phototransistor is shown in Fig. 23. As can be seen from this figure, the phototransistor consists equivalently of a photodiode using base-collector junction and an NPN transistor which amplifies the photocurrent output of the diode.

When a phototransistor is exposed to light with positive and negative voltages applied to its respective collector and emitter, the reversely biased photodiode (composed of the base-collector junction) produces a photocurrent which serves as the base current for the following transistor. The transistor provides an output current which is an h_{FE} multiple of the photocurrent.

$$I_C = I_P\,(1+h_{FE}) \simeq h_{FE} \cdot I_P$$

I_P: Photocurrent of the photodiode

h_{FE}: Common emitter amplification factor of the transistor

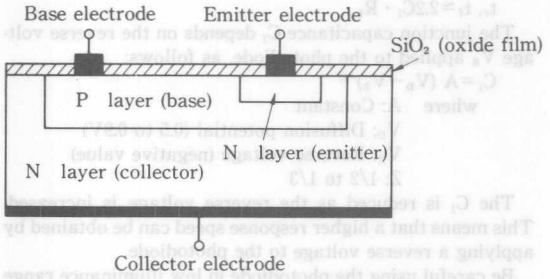


Fig. 22 Chip Structures of Phototransistor

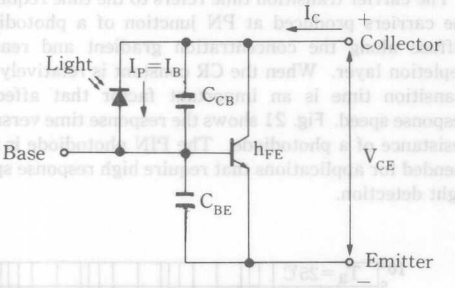


Fig. 23 Equivalent Circuit of Phototransistor

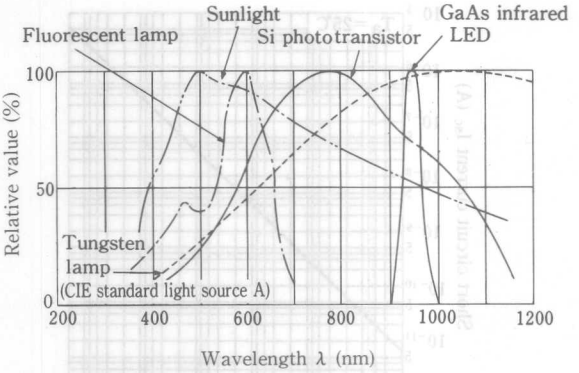


Fig. 24 Wavelength Characteristics

The spectral sensitivity of the phototransistors is similar to that of the photodiodes. Silicon phototransistors are sensitive to a wavelength of up to around 1,100 nm.

Fig. 24 shows the spectral distribution of several types of light sources and sensitivity of the silicon phototransistor. The wavelength band of the silicon phototransistor is similar to that of the GaAs infrared LED or tungsten lamp.

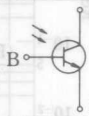
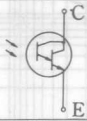
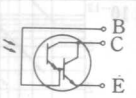
(2) Classifications

There are two types of phototransistors: single and Darlington phototransistors. Each type may or may not have a base terminal. Table 1 shows the available phototransistor types.

(3) Appearance and structures

Phototransistors are available in packages identical to those for infrared LEDs:

Table 1 Phototransistor Types

Type	Single phototransistor		Darlington phototransistor	
	Without base terminal	With base terminal	Without base terminal	With base terminal
Symbol				
Model No.	PT360, PT360F, PT370, PT371, PT420F, PT430, PT430F, PT480, PT480F, PT501, PT4800, PT4800F, PT4850F	PT510	PT361, PT361F, PT372, PT431, PT431F, PT481, PT481F, PT483F, PT491, PT491F, PT493, PT493F, PT4810, PT4810F	PT550, PT550F

(a) Can package
(b) Resin stem package
(c) Resin mold package

To prevent malfunctions due to external disturbing light (fluorescent lamps), some types use mold resin that cut off visible light.

(4) Electro-optical characteristics

① Collecter current versus collector-emitter voltage

The collector current versus collector-emritter voltage response of the phototransistor is similar to that of other types of transistors. The only exception is that the former uses illuminance instead of base current as a parameter.

Fig. 25 shows the collector current versus collector-emitter voltage response of a typical phototransistor.

In actual applications, care should be taken when loading the phototransistor so as not to exceed the rated collector power dissipation P_C.

Collector power dissipation P_C is given by the following formula :

$$P_C = I_C \cdot V_{CE}$$

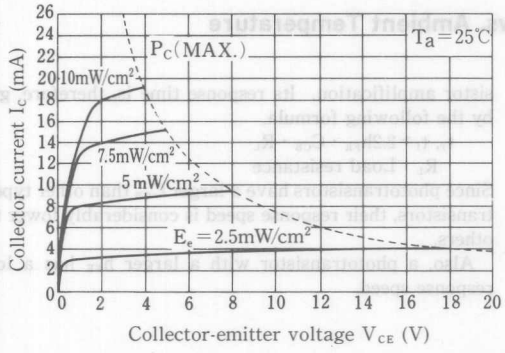


Fig. 25 Collector Current vs. Collector-emitter Voltage (PT501)

② Collector current versus irradiance

Since the h_{FE} of a phototransistor varies depending on the photocurrent I_P of its photodiode, the collector current I_C is not proportional to the illuminance, but is represented by the following formula.

$$I_C = \alpha E_e^N$$

where α : Constant
E_e : Irradiance
N : Constant ($\simeq$1.1)

Fig. 26 shows the collcetor current versus the irradiance of a typical phototransistor.

The PT501 is a single phototransistor, while the PT550 is a Darlington phototransistor.

Fig. 26 tells us that the PT550 has a higher sensitivity than the PT501, since the former has a larger collector current at a lower irradiance.

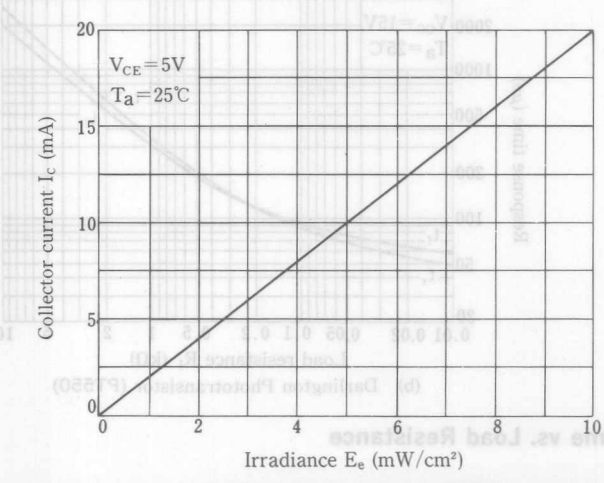
③ Collector dark current versus ambient temperature

The collector dark current of a phototransistor refers to the leak current in the incident light cut-off state. From the equivalent circuit shown in Fig. 23, we know that the dark current of a photodiode corresponds to the collector cut-off current, I_{CBO} of a common-base transistor and the collector current of a phototransistor is given by the following formula.

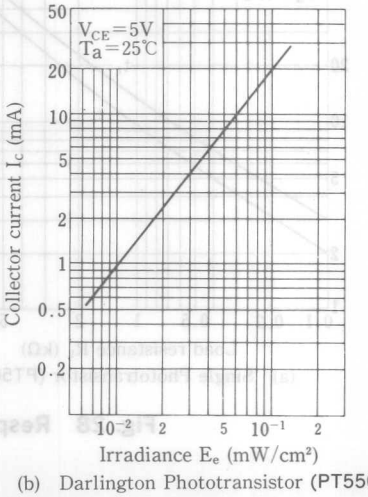
$$I_{CEO} = (1+h_{FE})\, I_d \simeq h_{FE} \cdot I_d$$

Since I_d depends on temperature, I_{CEO} also has a temperature characteristic as shown in Fig. 27 (I_{CEO} increases ten times when the temperature rises by 25°C).

When phototransistors are used in a high illuminance condition, temperature variation need not necessarily be taken into account since the collector current is much greater than the dark current (high signal-to-noise ratio). When they are operated in a low illuminance and high temperature condition, however, care should be taken

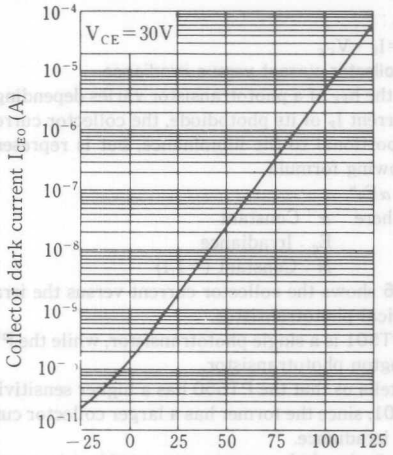


(a) Single Phototransistor (PT501)

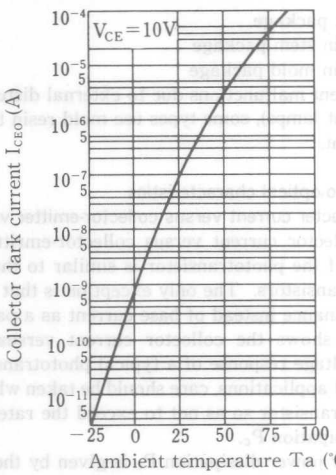


(b) Darlington Phototransistor (PT550)

Fig. 26 Collector Current vs. Irradiance



(a) Single Phototransistor (PT501)



(b) Darlington Phototransistor (PT550)

Fig. 27 Collector Dark Current vs. Ambient Temperature

because signal-to-noise ratio is reduced.

④ Acceptance

Similar to infrared LEDs, phototransistors have acceptance characteristics. In actual applications, narrow acceptance type devices must be oriented exactly to the incident light. For devices with wide acceptance, care must be taken to avoid malfunctions due to disturbing light.

⑤ Response time

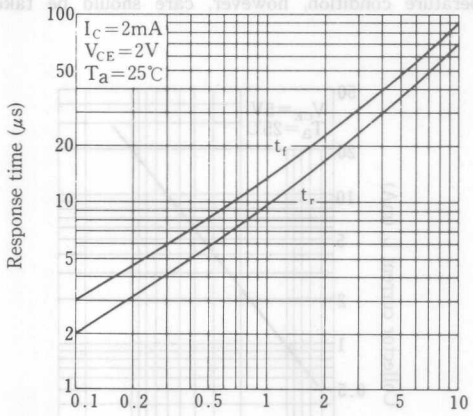
The collector-base junction capacitance C_{CB} of the phototransistor is apparently multiplied by h_{FE} due to transistor amplification. Its response time is, therefore, given by the following formula.

$$t_r,\ t_f \simeq 2.2 h_{FE} \cdot C_{CB} \cdot R_L$$

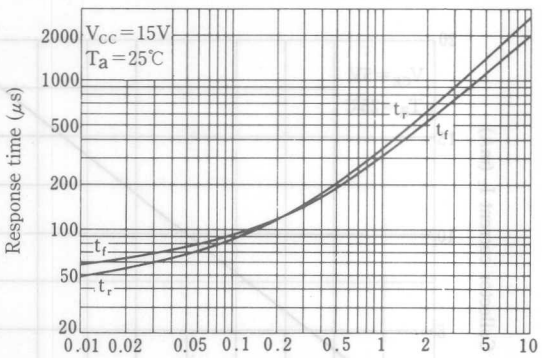
R_L : Load resistance

Since phototransistors have a larger C_{CB} than other types of transistors, their response speed is considerably lower than others.

Also, a phototransistor with a larger h_{FE} has a lower response speed.



(a) Single Phototransistor (PT501)



(b) Darlington Phototransistor (PT550)

Fig. 28 Response Time vs. Load Resistance

2-1-4 OPIC Light Detector

The OPIC is acronym for Optical Integrated Circuit, which integrates a photodiode, a signal processing circuit, and a voltage regulator onto a single chip. The block diagram of an OPIC light detector, IS486, is shown in Fig. 29.

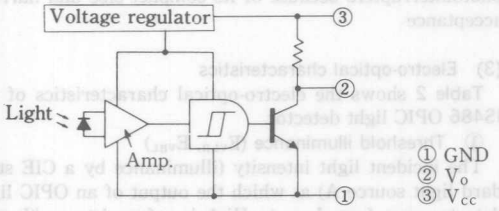


Fig. 29 Block Diagram of OPIC Light Detector (IS486)

The IS486 is a digital output type light detector, whose output is turned on or off depending on illuminance.

Because of direct interface capability with TTL, CMOS, and other logic circuits, the digital output type OPIC light detectors have the following advantages.

1) Simple circuit design.
2) Save space.
3) Reduces cost.

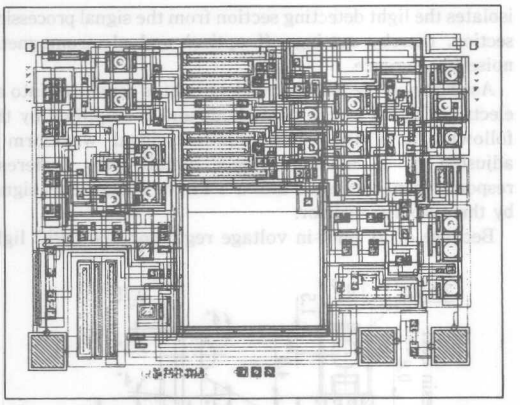
(1) Operating principle

Photo 1 shows an example of an OPIC chip. In Photo(a), the square area in the center represents a photodiode ; in Photo (b), the upper four rectangular areas represent a photodiode. All other areas on both chips are occupied by signal processing circuits.

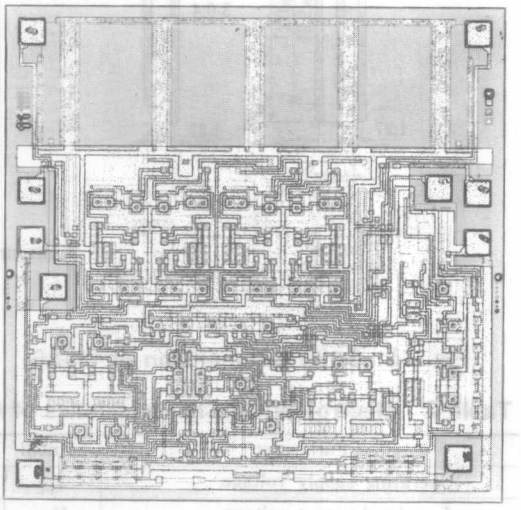
Fig. 30 shows a sectional view of an OPIC chip representing its basic structure.

The OPIC light detector chip is formed on a P-type substrate using the bipolar IC fabrication process.

The photodiode is formed with the PN junction of the substrate (P layer) and epitaxial layer (N layer). Its spectral sensitivity response is similar to the emission spectrum of the GaAs infrared LED. The introduction of the multilayer wiring technique optically and electromagnetically



(a) IS486



(b) Light Detector for Encoder

Photo 1 OPIC Light Detector Chip

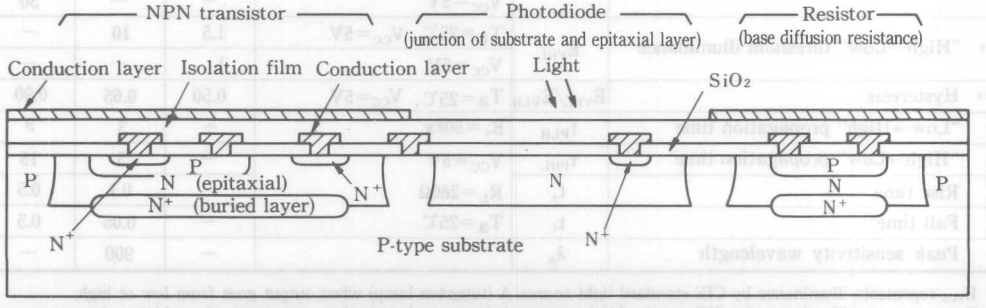


Fig. 30 Sectional View of OPIC Chip

isolates the light detecting section from the signal processing section, thereby cutting off optical and electromagnetic noise interference.

As shown in Fig. 29, the incident light is converted into an electrical signal by the photodiode and is amplified by the following amplifier. The amplified signal waveform is adjusted by a Schmidt trigger circuit with hysteresis response then, converted into a TTL, or CMOS level signal by the output transistor.

Because of its built-in voltage regulator, the OPIC light detector is capable of operating from a wide range of supply voltage.

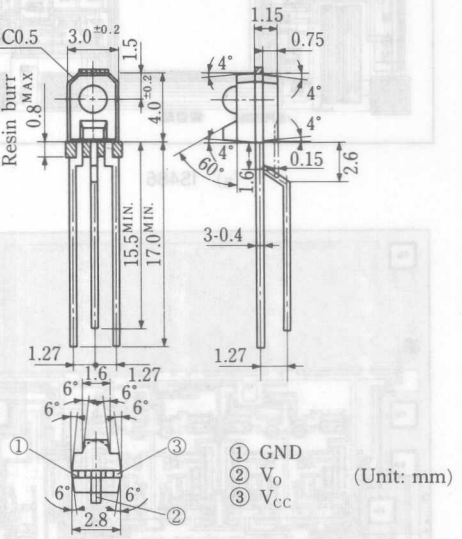


Fig. 31 Outline Dimension of IS486

(2) Appearance and structures

Fig. 31 is a package outline drawing of the IS486 OPIC light detector. The IS486 is molded by resin with a semi-spherical lens, and in used chiefly for the detector of photointerrupters because of its compact size and narrow acceptance

(3) Electro-optical characteristics

Table 2 shows the electro-optical characteristics of the IS486 OPIC light detector.

① Threshold illuminance (E_{VLH}, E_{VHL})

The incident light intensity (illuminance by a CIE standard light source A) at which the output of an OPIC light detector goes from Low to High is referred to as "Low→High" threshold illuminance E_{VLH}, while that at which the output gose from High to Low is referred to as "High→Low" threshold illuminance (E_{VHL}). The IS486 is a very high sensitive device whose E_{VLH} is typically as low as 15ℓx. "High→Low" threshold illuminance of the IS486 is typically 10ℓx, which implies that the device has a hysteresis response.

Both E_{VLH} and E_{VHL} have a negative dependence on ambient temperature. The temperature responses of E_{VLH} and E_{VHL} are shown in Fig. 32.

② Propagation time (t_{PLH}, t_{PHL})

Fig. 33 shows "Low→High" propagation time (t_{PLH}) and "High→Low" propagation time (t_{PHL}) of the IS486 in relation to illuminance. The IS486 has a high response time (t_{PLH} : TYP. 3μs, t_{PHL} : TYP. 5μs) while featuring high sensitivity.

Table 2 Electro-optical Characteristics of OPIC Light Detector (Ta=0~70°C, unless specified)

	Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
	Operating supply voltage	V_{CC}	Ta=25°C	−0.5	—	17	V
	Low level output voltage	V_{OL}	I_{OL}=16mA, V_{CC}=5V, E_v=0	—	0.15	0.4	V
	High level output voltage	V_{OH}	V_{CC}=5V, E_v=50ℓx	3.5	—	—	V
	Low level supply current	I_{CCL}	V_{CC}=5V, E_v=0	—	1.7	3.8	mA
	High level supply current	I_{CCH}	V_{CC}=5V, E_v=50ℓx	—	0.7	2.2	mA
※1	"Low→High" threshold illuminance	E_{VLH}	Ta=25°C, V_{CC}=5V	—	15	35	ℓx
			V_{CC}=5V	—	—	50	
※2	"High→Low" threshold illuminance	E_{VHL}	Ta=25°C, V_{CC}=5V	1.5	10	—	ℓx
			V_{CC}=5V	1	—	—	
※3	Hysteresis	E_{VHL}/E_{VLH}	Ta=25°C, V_{CC}=5V	0.50	0.65	0.90	—
Response time	"Low→High" propagation time	t_{PLH}	E_v=50ℓx	—	3	9	μs
	"High→Low" propagation time	t_{PHL}	V_{CC}=5V	—	5	15	
	Rise time	t_r	R_L=280Ω	—	0.1	0.5	
	Fall time	t_f	Ta=25°C	—	0.05	0.5	
	Peak sensitivity wavelength	λ_p		—	900	—	nm

※1 E_{VLH} represents illuminance by CIE standard light source A (tungsten lamp) when output goes from low ot high.
※2 E_{VHL} represents illuminance by CIE standard light source A (tungsten lamp) when output goes from high to low.
※3 Hysteresis stands for E_{VHL}/E_{VLH}.

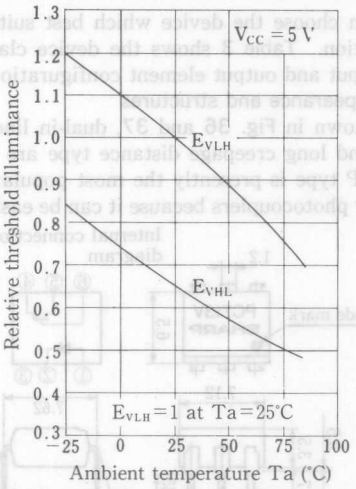


Fig. 32 Relative Thresholed Illuminance vs. Ambient Temperature

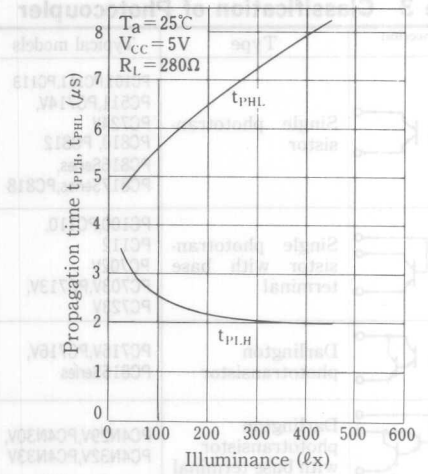
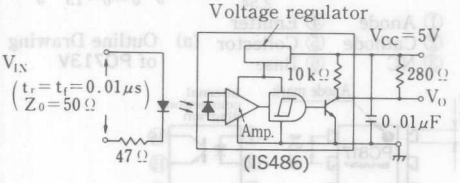
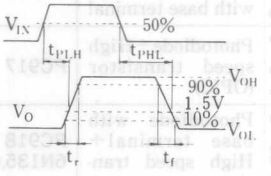


Fig. 33 Propagation Time vs. Illuminance (IS486)



(a) Test Circuit for Response Time



(b) Timing Chart

Fig. 34 Test Condition for Propagation Time

2-1-5 Photocoupler Photothyristor Coupler Phototriac Coupler

1. Photocoupler

(1) Operating principle

The photocoupler is a combination of light emitter and light detector. It is intended to transfer signals in the form of light while electrically isolating input from output. The basic operating principle of the photocoupler is illustrated in Fig. 35.

In general, the GaAs infrared LED is used as the light emitter for photocouplers because of its high emission efficiency, while the silicon (Spi) phototransistor or photodiode is used as the light detecting element. Recently, the OPIC light detector, which integrates a photodiode with signal processing circuit (amplifier, waveform adjustment circuit, etc.) onto a single chip, are increasingly employed in photocouplers.

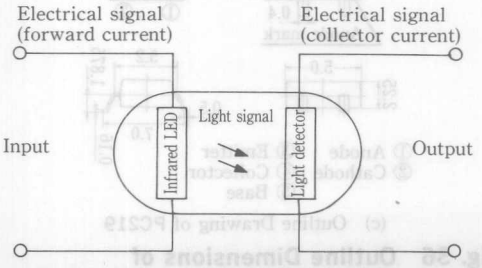


Fig. 35 Operating Principle of Photocoupler

The photocoupler has the following features.

① The output is electrically isolated from the input.
② Capable of wide-band signal transmission, from DC to high frequency.
③ Uni-directional signal transfer means that output noise does not loop back to the input circuit.
④ Easy interfacing with logic devices.
⑤ Compact and light.

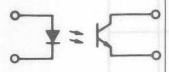
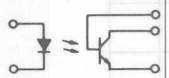
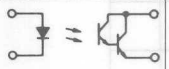
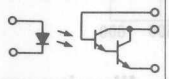
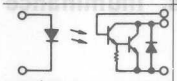
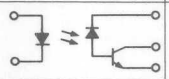
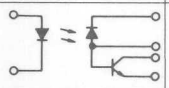
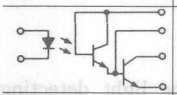
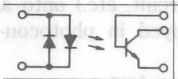
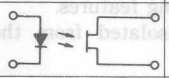
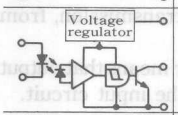
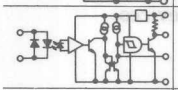
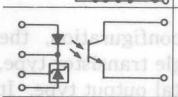
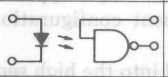
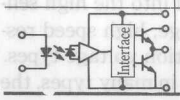
(2) Classification

Depending on output element configuration, the photocoupler is available in the single transistor type, Darlington transistor type, and digital output type. It is also classified by its input element configuration into DC and AC drive types.

In functional terms, it is classified into the high sensitivity, high collector-emitter voltage, high speed response, analog output, and high isolation voltage types.

Since photocouplers are available in many types, the

Table 3 Classification of Photocoupler

Internal connection diagram	Type	Typical models
	Single phototransistor	PC101,PC111,PC113 PC511,PC714V, PC724V PC810, PC812 PC816Series, PC817Series,PC818
	Single phototransistor with base terminal	PC100,PC110, PC112 PC702V PC703V,PC713V, PC723V
	Darlington phototransistor	PC715V,PC716V, PC815Series
	Darlington phototransistor with base terminal	PC4N29V,PC4N30V, PC4N32V,PC4N33V
	Darlington phototransistor with base terminal	PC725V
	Photodiode+High speed transistor (OPIC)	PC917
	Photodiode with base terminal+ High speed transistor	PC918 6N135,6N136
	High speed, high sensitivity transistor output (OPIC)	6N139
	AC input response	PC813Series PC814Series
	AC input response with base terminal	PC733,PC733H
	Bi-directional analog FET output	PC619
	Digital output (OPIC)	PC900V
	AC input response, digital output (OPIC)	PC902
	Transistor output with built-in voltage deviation detection circuit	PC904
	Super-high speed digital output (OPIC)	PC910
	High output (OPIC)	PC921

user can choose the device which best suits his own application. Table 3 shows the device classified by their input and output element configurations.

(3) Appearance and structures

As shown in Fig. 36 and 37, dual-in line package (DIP) and long creepage distance type are available. The DIP type is presently the most popular package type for photocouplers because it can be easily mount-

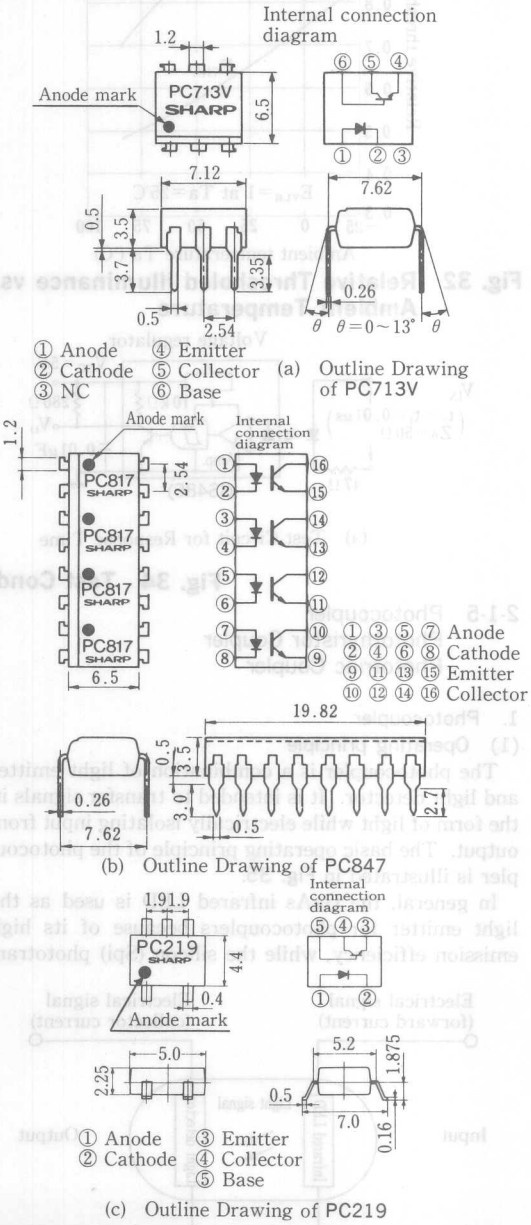


Fig. 36 Outline Dimensions of Photocouplers (Unit : mm)

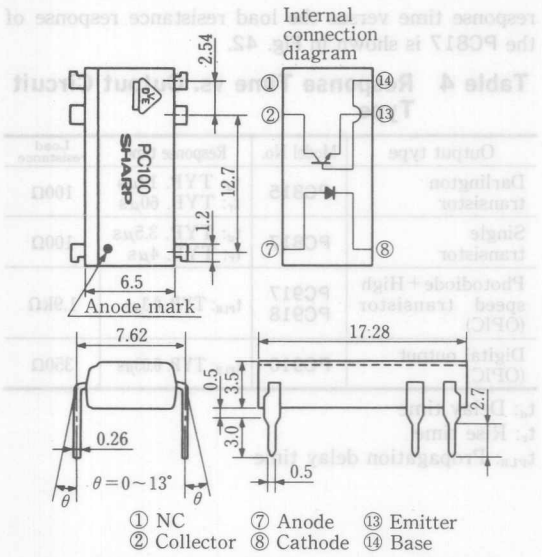


Fig. 37 Outline Dimensions of PC100

ed on PWB. While DIP type photocouplers generally have six pins, some devices have four pins or may be of multi-channel type for improved mounting density.

Fig. 38 and 39 show the internal structures of a photocoupler. A typical DIP type photocoupler consists of an infrared LED and phototransistor facing each other, around which an optical path is formed by semitransparent epoxy resin. And it is further molded with black non-flammable epoxy resin (double transfer molding).

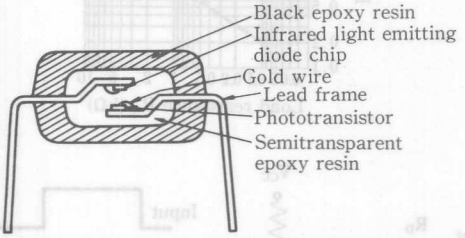


Fig. 38 Internal Structures of PC713V/PC847

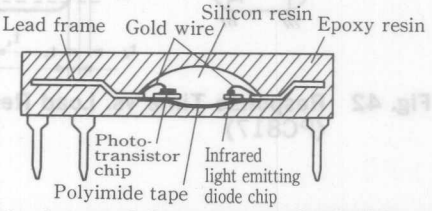


Fig. 39 Internal Structures of PC100

(4) Electro-optical characteristics

① Current transfer ratio versus forward current

The current transfer ratio (CTR) refers to the ratio of the output collector current (I_c) to the input forward current (I_F). It is one of the most important characteristics of photocouplers.

$$CTR=\frac{I_c}{I_F}\times 100(\%)$$

The CTR greatly differs depending on the type of the phototransistor used in the photocoupler. The photocoupler using Darlington phototransistor can provide a relatively large collector current from a small input forward current (PC815 CTR: MIN. 600%). Photocouplers using a single phototransistor provide a relatively small CTR (PC817 CTR: MIN. 50%). The CTR also depends on the construction of the photocoupler. When choosing a photocoupler, it is necessary to examine its input driving current and output necessary current. It should be noted that the CTR varies depending chiefly on the input forward current (I_F).

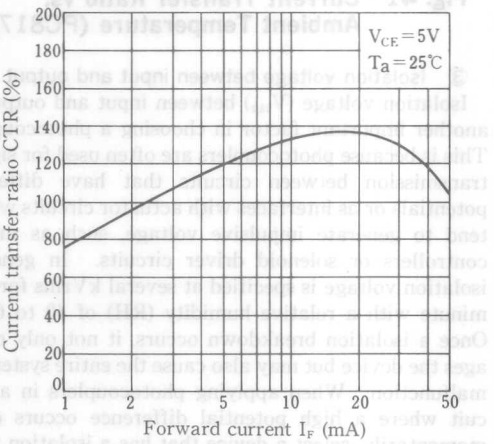


Fig. 40 Current Transfer Ratio vs. Forward Current (PC817)

Fig. 40 shows a typical current transfer ratio versus forward current response of a photocoupler.

② Current transfer ratio versus ambient temperature

The current transfer ratio (CTR) varies with ambient temperature. The temperature coefficients of the photosensitivity and h_{FE} of silicon phototransistors are both approximately +0.7%/°C; that of the optical output of GaAs infrared LEDs is approximately −1.0%/°C. When a silicon phototransistor is coupled with a GaAs infrared LED, their temperature coefficients tend to cancel each other. However, since the temperature coefficient of the GaAs infrared LED is greater than that of the Si phototransistor and peak emission wavelength of the LED shifts towards the long wavelength as the temperature rises, CTR tends to lower as the temperature rises.

Fig. 41 shows the current transfer ratio versus ambient temperature characteristics of a photocoupler.

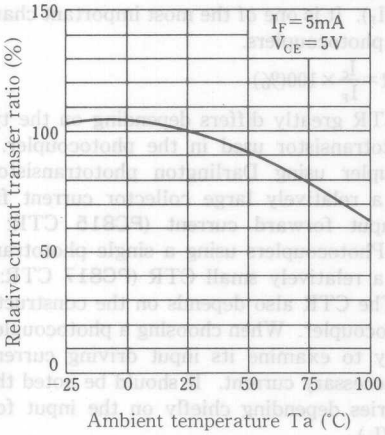


Fig. 41 Current Transfer Ratio vs. Ambient Temperature (PC817)

③ Isolation voltage between input and output

Isolation voltage (V_{iso}) between input and output is another important factor in choosing a photocoupler. This is because photocouplers are often used for signal transmission between circuits that have different potentials or as interfaces with actuator circuits which tend to generate impulsive voltage, such as motor controllers or solenoid driver circuits. In general, isolation voltage is specified at several kVrms for one minute with a relative humidity (RH) of 40 to 60%. Once a isolation breakdown occurs, it not only damages the device but may also cause the entire system to malfunction. When applying photocouplers in a circuit where a high potential difference occurs even momentarily, select a device that has a isolation voltage sufficiently higher than the maximum potential difference.

Our representative photocoupler models, PC700V and PC800 series or PC511, etc. . . . all have a V_{iso} of more than 5,000Vrms to guarantee a very high isolation voltage.

④ Response time

The response time of a photocoupler depends chiefly on the output phototransistor. However, photocouplers using an OPIC light detector (in which a potodiode and signal processing circuit are integrated into a single chip), may be affected in response time by that of the LED.

Table 4 shows response times versus output circuit types. The response time also depends on the input forward current (I_F) and load resistance (R_L). Since load resistance has a greater influence on the response time, be careful in setting the circuit constant. The response time versus the load resistance response of the PC817 is shown in Fig. 42.

Table 4 Response Time vs. Output Circuit Type

Output type	Model No.	Response time	Load resistance
Darlington transistor	PC815	t_d: TYP. 10μs t_r: TYP. 60μs	100Ω
Single transistor	PC817	t_d: TYP. 3.5μs t_r: TYP. 4μs	100Ω
Photodiode+High speed transistor (OPIC)	PC917 PC918	t_{PLH}: TYP. 0.3μs	1.9kΩ
Digital output (OPIC)	PC910	t_{PLH}: TYP. 0.05μs	350Ω

t_d: Delay time
t_r: Rise time
t_{PLH}: Propagation delay time

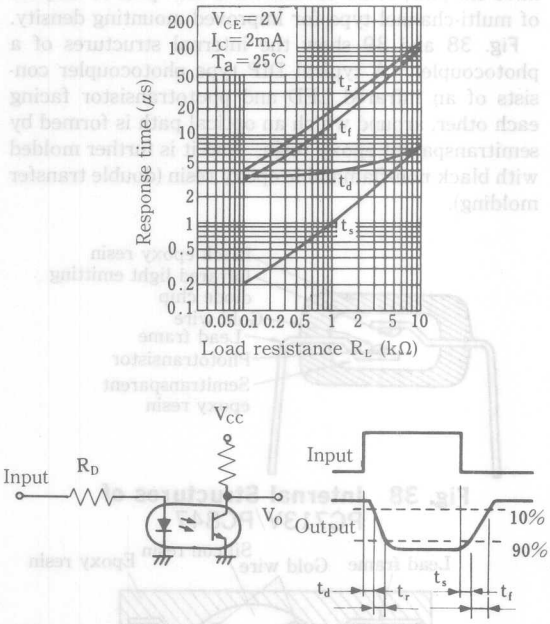


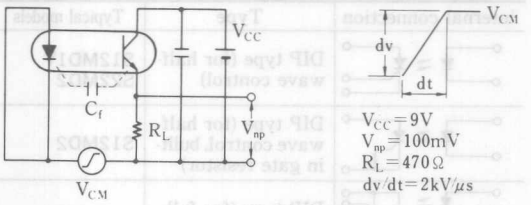
Fig. 42 Response Time vs. Load Resistance (PC817)

⑤ Common mode rejection (CMR) characteristic

While the photocoupler's output is electrically isolated from its input for relatively low frequency signal, an impulsive input voltage may cause a displacement current ($i_d = C_f \cdot dv/dt$) to flow due to the floating capacitance (C_f) between the input and output of the photocoupler, causing noise voltage to appear at the output.

The CMR characteristic is represented by a common mode rejection voltage (V_{CM}) which is specified under the condition of output peak noise voltage (V_{np}) of 100mV (at $R_L = 470\Omega$) and voltage rising rate of 2kV/μs. For the PC812, the V_{CM} is typically 1.5kV.

Test circuit for V_{CM} is shown in Fig. 43.



(a) Test Circuit (b) Test Condition

Fig. 43 Test Circuit for V_{CM}

2. Photothyristor Coupler Phototriac Coupler

The photothyristor coupler and phototriac coupler trigger a medium/large power thyristor or triac by turning ON photothyristor or phototriac on the output, after flowing current into infrared LED on the input.

(1) The operating principle of photothyristors

When a semiconductor is exposed to light whose energy is higher than the semiconductor's band gap, a collector current flows to put the device in a low resistance state.

This is also true of the thyristor. When a photothyristor is exposed to near infrared or visible light, it is turned on with a photocurrent's flow. The photothyristor chip is very similar in construction to other types of thyristors. To increase optical sensitivity, the photothyristor is specially designed for smaller gate trigger current (I_{GT}). The chip structure is shown in Fig. 44.

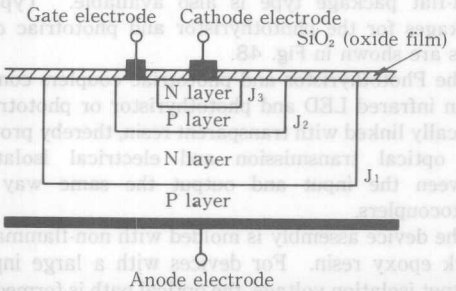


Fig. 44 Structure Drawing of Photothyristor Chip

The operation of the photothyristor can be explained by using the transistor-equivalent circuit shown in Fig. 45. When we assume that the current amplification factor of the PNP transistor Q_1 is α_1 and that of the NPN transistor Q_2 is α_2, the turn-on condition of the photothyristor may be approximated using the following formulas:

$$I_{B1} = (1-\alpha_1)I_A - I_{CBO1}$$
$$I_{C2} = \alpha_2 Ik + I_{CBO2}$$
$$I_{B1} = I_{C2}$$
$$I_k = I_A + I_G + I_P$$
$$I_A = \frac{\alpha_2(I_G + I_P) + I_{CBO1} + I_{CBO2}}{1-(\alpha_1+\alpha_2)}$$

For a photothyristor to be turned on, $\alpha_1+\alpha_2$ must be equal to or greater than one. Both α_1 and α_2 depend on photocurrent. The photocurrent I_P serves as the base current for each transistor. As a result, α_1 and α_2 vary with the base current. The condition, $\alpha_1+\alpha_2 \geqq 1$, is fulfilled at a certain illuminance, causing the photothyristor to be turned on.

Fig. 46 illustrates these operations by using the energy band structures of the phtotothyristor.

Fig. 46 (a) shows PNPN junctions in a thermal equilibrium state. The depletion layers at the PN junctions J_1, J_2, and J_3 are narrow.

Fig. 46 (b) shows the off state under forward bias.

While junctions J_1 and J_3 have narrow depletion layers under forward bias, junction J_2 has a wider depletion layer under reverse bias. In this state, base areas N_1 and P_2 have almost no carrier storage. Most of the bias voltage (V) is applied across junction J_2.

If a breakdown occurs at junction J_2, if carrier injection from the P_1 or N_2 layer increases, or if photocurrent increases as a result of incident light striking J_2, carriers are stored in base layers N_1 and P_2. When the condition $\alpha_1+\alpha_2 \geqq 1$ is fulfilled, this PNPN element is turned on (conduction state). The turn-on

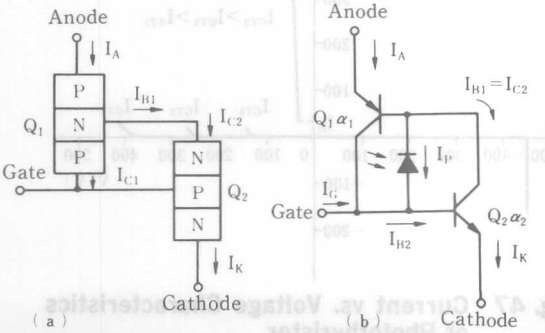


Fig. 45 Equivalent Circuit of Photothyristor

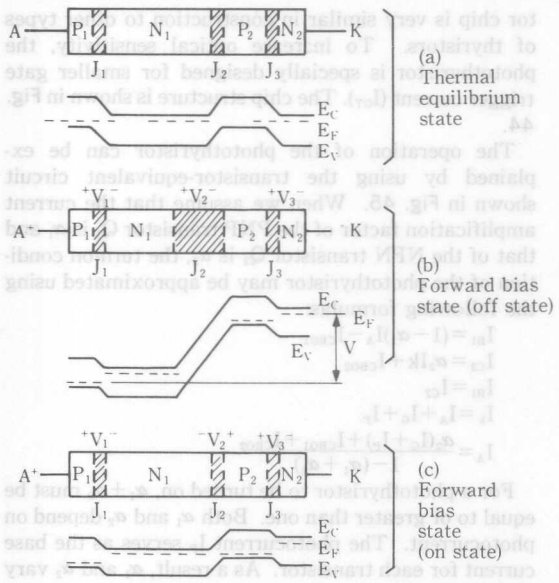


Fig. 46 Energy Band Structures of Photothyristor

state is illustrated in Fig. 46 (c). In this figure, junctions J_1, J_2, and J_3 are all biased in the forward direction, with a plenty of carriers stored in the base layers N_1 and P_2.

Since the photothyristor has a peak sensitivity in the near infrared band, it is suited for combined use with infrared LEDs. Also photothyristors allow high isolation voltage design and are capable of directly controlling 100 or 200 VAC power, making them suitable as the SSR.

A current versus voltage response of a photothyrtistor is shown in Fig. 47.

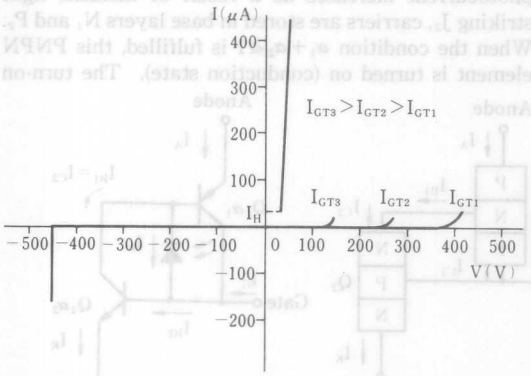


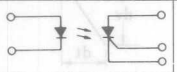
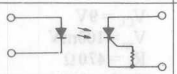
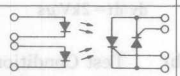
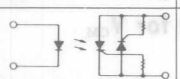
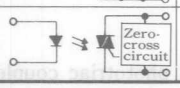
Fig. 47 Current vs. Voltage Characteristics of Photothyristor

(2) Classification

Depending on internal structure, the photothyristor and phototriac couplers are divided as shown in the Table 5.

The photothyristor and phototriac couplers have a current capacity of 100 to 300mA. They consist of an infrared LED and photothyristor or phototriac, and are suited for triggering high power thyristors or triacs with a current capacity of 100A or less, In addition, a type integrated with zero-cross circuit into a single chip is also available.

Table 5 Classification of Photothyristor and Phototriac Couplers

Internal connection	Type	Typical models
	DIP type (for half-wave control)	S12MD1V S22MD2
	DIP type (for half-wave control, built-in gate resistor)	S12MD2
	DIP type (for full-wave control)	S12MD3
	DIP type (for full-wave control, built-in gate resistor)	S11MD5V S21MD3V
	DIP type (for full-wave control, built-in zero-cross circuit)	S21MD4V

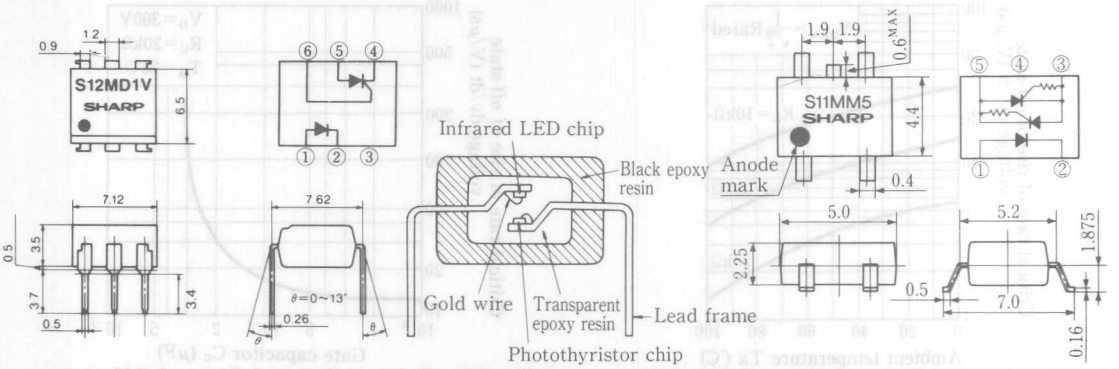
(3) Appearance and structures

① SSR for triggering

Photothyristor and phototriac couplers are generally available in dual-in-line packages to facilitate mounting on PWB. The half-wave controlling type comes in 4- or 6-pin dual-in-line packages, while the full-wave controlling type comes in 6- or 8-pin dual-in-line packages. In addition to these, there are also some types which have a long anode-cathode distance on the output photothyristor so as to meet the requirements of the Electrical Appliances Regulational Act of Japan. In addition, for mounting on hybrid substrate, mini-flat package type is also available. Typical packages for the photothyristor and phototriac couplers are shown in Fig. 48.

The Photothyristor and phototriac couplers consist of an infrared LED and photothyristor or phototriac, optically linked with transparent resin, thereby providing optical transmission and electrical isolation between the input and output the same way as photocouplers.

The device assembly is molded with non-flammable black epoxy resin. For devices with a large input-ouptput isolation voltage, the optical path is formed by a transfer mold, and the assembly is further molded with non-flammable black resin (double transfer mold).



(a) DIP type (S12MD1V) Unit : mm (b) Internal Structures (S12MD1V) (c) Mini-flat package type (S11MM5) Unit : mm

Fig. 48 Package Structures of Photothyristor Coupler/Phototriac Coupler

(4) Electro-optical characteristics

① RMS on-state current versus ambient temperature

The temperature of the component junctions (T_j) in photothyristor and phototriac couplers must always be below the maximum rated junction temperature (T_{jMAX}).

When the ambient temperature is high, their RMS on-state current (I_T) should be reduced according to the RMS on-state current reduction curve.

Fig. 49 shows the RMS on-state current reduction curve.

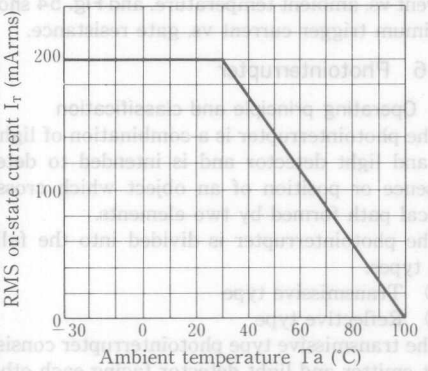


Fig. 49 RMS On-state Current vs. Ambient Temperature (S21MD1V)

② Repetitive peak off-state current versus ambient temperature

The repetitve peak off-state current (I_{DRM}) refers to a leak current passing through a photothyristor or phototriac when a rated repetitive peak off-state voltage is applied. It is no more than 1μA at the normal temperature (Ta=25°C). While I_{DRM} is negligibly small at the normal temperature, it increases exponentially as the temperature rises. When the triggering SSR is to be used at high temperature (especially the photothyristor type with an external gate resistor), its gate circuit must be designed carefully to prevent malfunctions.

Fig. 50 show the repetitive peak off-state current versus ambient temperature responses of the S12MD1V.

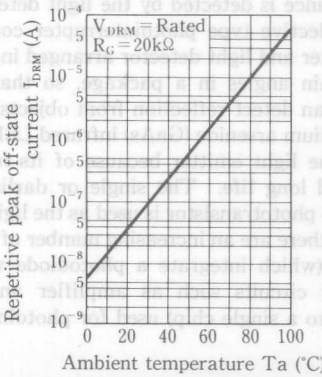


Fig. 50 Repetitive Peak Off-state Current vs. Ambient Temperature (S12MD1V)

③ Critical rate of rise of off-state voltage (dv/dt)

When a rapidly rising forward voltage is applied across the anode and cathode of a photothyristor with no input signal applied, the device may be turned on even if the applied voltage is below the rated repetitive peak off-state voltage (V_{DRM}). This is because of a displacement current, $i_d = C_j \cdot V_{2\frac{1}{3}} \, dv/dt$ (A), passing through the junction capacitance (J_2 in Fig. 44) of the device. The displacement current functions the same an a photocurrent (I_p), and causes the photothyristor to be turned on if the condition $\alpha_1 + \alpha_2 \geqq 1$ is fulfilled.

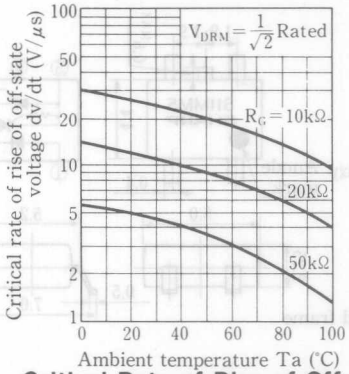


Fig. 51 Critical Rate of Rise of Off-state Voltage vs. Ambient Temperature (S12MD1V)

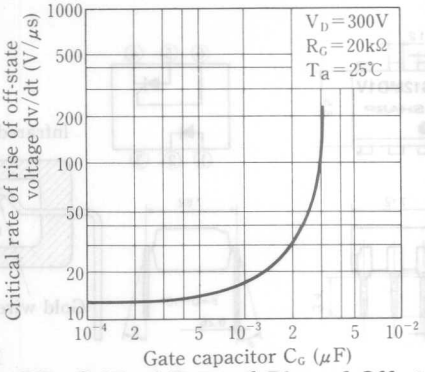


Fig. 52 Critical Rate of Rise of Off-state Voltage vs. Gate Capacitor (S12MD1V)

④ Minimum Trigger Current

Minimum trigger current (I_{FT}) is the minimum input current required for a photothyristor or a photothriac to change from OFF to ON state. It is determined by the luminous intensity of LED on input side as well as by the sensitivity of the photothyristor or photothriac.

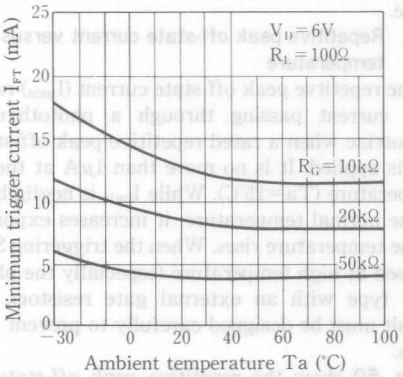


Fig. 53 Minimum Trigger Current vs. Ambient Temperature

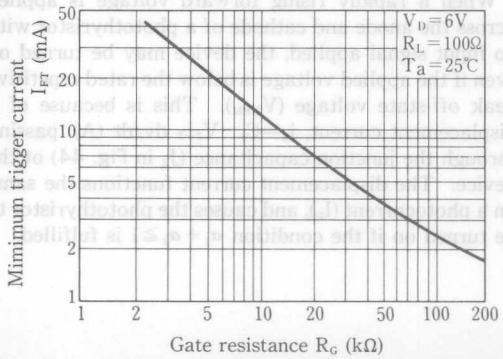


Fig. 54 Mimimum Trigger Current vs. Gate Resistance

The minimum trigger current is normally between 5mA and 15mA, depending upon the ambient temperature and gate resistance (R_G). Note that, with larger R_G value, I_{FT} is smaller but critical rate of rise of off-state voltage also decreases, resulting in decreased noise resistance. Fig. 53 shows the minimum trigger current vs. ambient temperature, and Fig. 54 shows the minimum trigger current vs. gate resistance.

2-1-6 Photointerrupter

(1) Operating principle and classification

The photointerrupter is a combination of light emitter and light detector and is intended to detect the presence or position of an object which crosses the optical path formed by two elements.

The photointerrupter is divided into the following two types.

① Transmissive type
② Reflective type

The transmissive type photointerrupter consists of a light emitter and light detector facing each other at a certain distance in a package. When an object crosses the gap across the two elements, the resulting change in illuminance is detected by the light detector.

The reflective type photointerrupter consists of a light emitter and light detector arranged in parallel or at a certain angles in a package, so that the light detector can detect reflection from objects.

The gallium arsenide (GaAs) infrared LED is usually used as the light emitter because of its high output power and long life. The single or darlington type silicon (Si) phototransistor is used as the light detector. Recently, there are an increasing number of OPIC light detectors (which integrate a photodiode with signal processing circuits such as amplifier and Schmidt trigger onto a single chip) used for photointerrupters.

The photointerrupter has the following features.

① Contactless detection capability.
② Compact, highly reliable, with a long life.
③ High sensing accuracy.
④ High speed response.
⑤ TTL and CMOS compatible output.

Photointerrupters are now widely used as optical sensors in industrial and consumer applications.

(2) Appearance and structures

Fig. 55 shows the structures of a transmissive type photointerrupter.

The infrared LED and phototransistor are contained in a resin molded package each with a lens and annembled into an integrated device inside an outer case. To provide a resolution that corresponds to the sensing accuracy, a slit (0.25 to 2.0mm) is provided in each of the light emitter and detector windows. The detecting gap length (0.9 to 13mm) and mounting methed are optional according to applications.

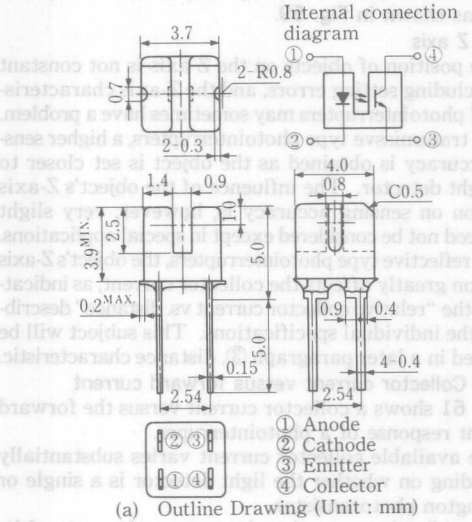


Fig. 56 Compact Transmissive Type Photointerrupter (GP1S07)

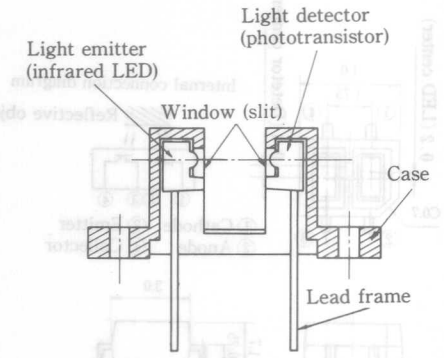


Fig. 55 Internal Structures of Transmissive Type Photointerrupter (GP1S01)

Fig.56 shows the structures of a compact transmissive type photointerrupter.

Unlike the current transmissive type photointerrupter, a light emitter/detector are assembled into one unit by 2-layer resin mold system.

This photointerrupter is most suitable for use in a small equipment, such as a camera due to its compact design.

Because of the ease of handling as a sensor and ease of signal transmission, the type employing a connector terminal is also available, which is used for a copier, for example.

Fig.57 shows the structures of reflective type photointerrupter. The light detecting window is provided with a visible light cut-off filter to reduce malfunctions caused by disturbing light.

Fig.58 shows the structures of a reflective type compact photointerrupter in a dual-in-line package. The integrated structure using a double-layer resin mold allows for the device subminiature, as small as 0.02 cc in volume. The compact size makes the device suitable for applications in compact equipment.

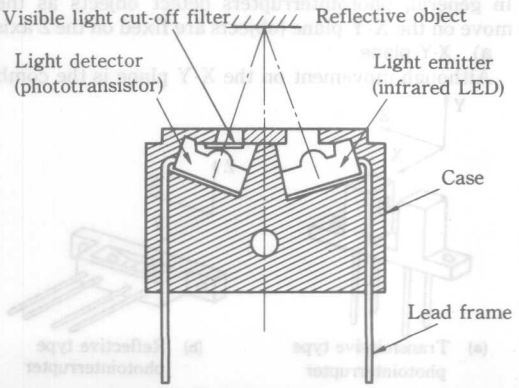
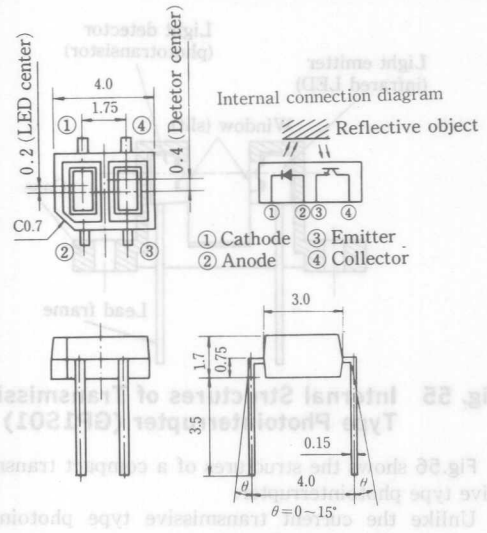
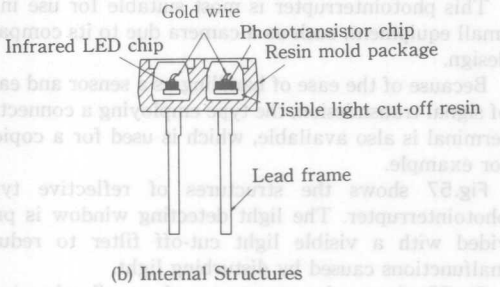


Fig. 57 Internal Structures of Reflective Type Photointerrupter (GP2S03)



(a) Outline Drawing (Unit: mm)



(b) Internal Structures

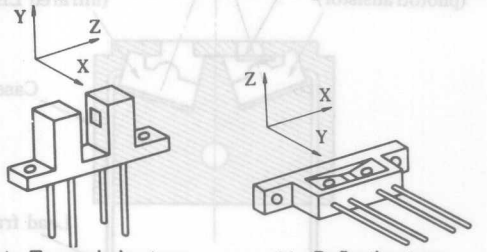
Fig. 58 Reflective Type Compact Photointerrupter (GP2S04)

(3) Electro-optical characteristics

We represent the object detection space of a photointerrupter using the X, Y, and Z axes shown in Fig. 47. In general, photointerrupters detect objects as they move on the X-Y plane (objects are fixed on the Z axis).

a) X-Y plane

Although movement on the X-Y plane is the combination of movements along both the X and Y axes, photointerrupters are designed to center on movement along the X axis. The sensing accuracy, therefore, is greater along the X axis than along the Y axis, in general. It is necessary, therefore, to arrange the device so that the object move along the X axis.



(a) Transmissive type photointerrupter (b) Reflective type photointerrupter

Fig. 59 Object Detection Space of Photointerrupter

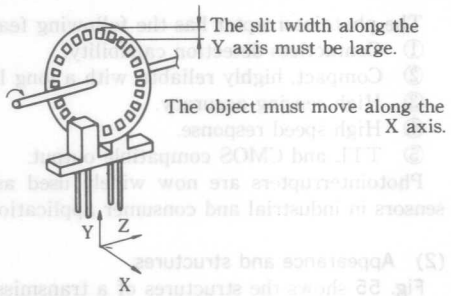


Fig. 60 Example of Optical Path Design Along the Y Axis

The detective object must be sufficiently wide along the Y axis so that it can completely cut off the optical path, as shown in Fig. 59.

b) Z axis

The position of objects on the Z axis is not constant but including setting errors, and the Z-axis characteristics of photointerrupters may sometimes have a problem.

For transmissve type photointerrupters, a higher sensing accuracy is obtained as the object is set closer to the light detector. The influence of the object's Z-axis position on sensing accuracy is, however, very slight and need not be considered except in special applications.

For reflective type photointerrupters, the object's Z-axis position greatly affects the collector current, as indicated by the "relative collector current vs. distance" described in the individual specifications. This subject will be detailed in a later paragraph ③, distance characteristic.

① Collector current versus forward current

Fig. 61 shows a collector current versus the forward current response of a photointerruper.

The available collector current varies substantially depending on whether the light detector is a single or Darlington photoransistor.

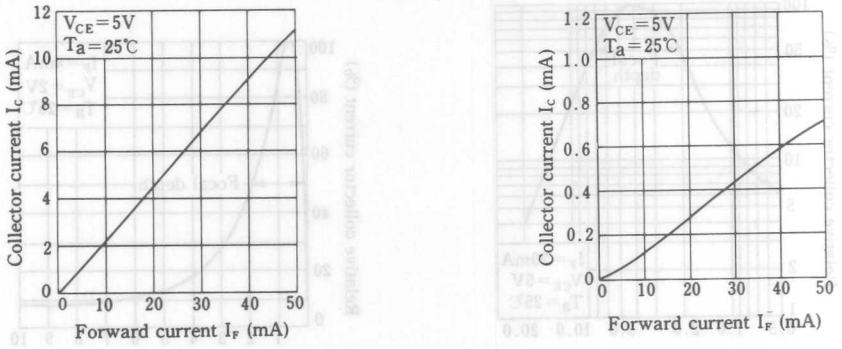
The reflective type photointerrupter, because of its small collector current, is prone to malfunctions caused by disturbing light. Hence, it must be carefully used.

② Detecting position characteristic

Collector current variations which accompany object movement are referred to as detecting position characteristic. A typical detecting position characteristic is show in Fig. 62.

Sensing accuracy depends on the beam angle of the light emitter and the acceptance of the detector and the optical path width derived from the width of the slit in the package. Sensing accuracy is thus different in each device type.

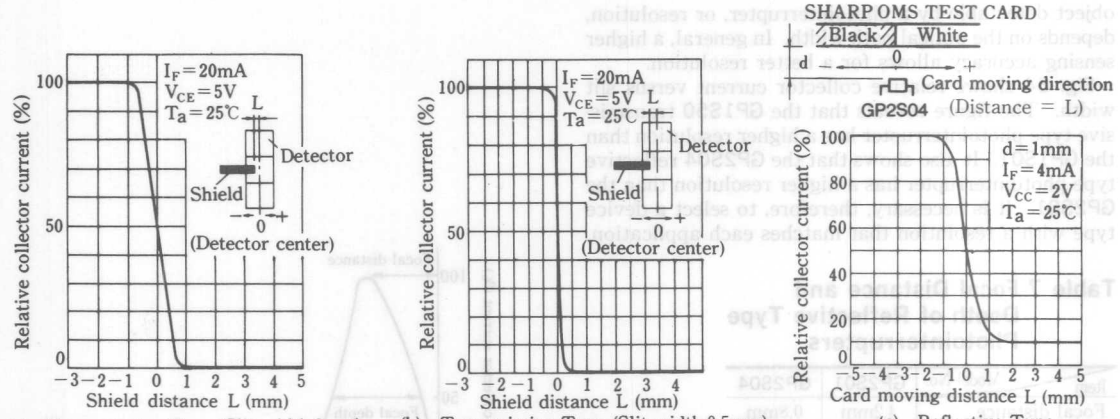
The sensing accuracies can be compared by the object shift distances which cause relative collector current variations from 10% to 90%. A device with a higher sensing accuracy provides a smaller collector current. The user should select the optimun device for each application.



(a) Transmissive Type (Single Phototransistor Output) GP1S01, GP1S01F

(b) Reflective Type (Single Phototransistor Output) GP2S01, GP2S01F

Fig. 61 Collector Current vs. Forward Current



(a) Transmissive Type (Slit width:2mm) GP1S01, GP1S01F

(b) Transmissive Type (Slit width:0.5mm) GP1S50

(c) Reflective Type GP2S04

Fig. 62 Detecting Position Characteristics

Table 6 compares some device types in terms of sensing accuracy and minimum collector current.

The surface condition of the object affects the sensing accuracy of reflective type photointerrupters. A mirror surface allows for a higher sensing accuracy than that obtained with paper surfaces or other surfaces with highly irregular reflection. The sensing accuracy is maximized when the object is positioned at the focus of the photointerrupter

Table 6 Sensing Accuracy and Minimum Collector Current

	Transmissve type		Reflective type	
	GP1S01	GP1S50	GP2S01	GP2S04
Distance causing collector current variations of 10 to 90%	1.0mm	0.38mm	3.2mm	2.2mm
Minimum collector current (LED's forward current)	2mA (I_F=20mA)	0.5mA (I_F=20mA)	200μA (I_F=20mA)	20μA (I_F=4mA)

A metal plate is used as the shield for transmissive type photointerrupters.
The SHARP OMS TEST CARD is used as the reflective plate for reflective type photointerrupters.

③ Distance characteristic

The distance characteristic represents the focal distance and focal depth (range in which a relative collector current of 50% or more can be obtained) for the reflective type photointerrupter. Fig. 63 shows the relative collector current versus distance characteristic.

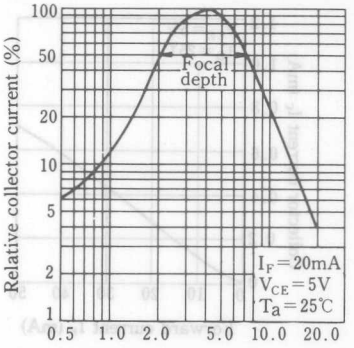
From this figure we can determine the optimum distance between the object and sensor as well as the collector current variation resulting from object shifts along the Z axis.

Since the distance characteristic depends on the beam angle of the light emitter and the acceptance of the detector or their relative positions, the user should select the optimum device type by considering all operating conditions.

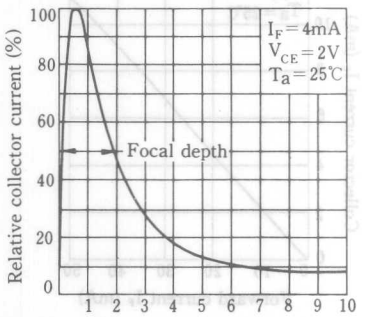
Table 7 compares typical reflective type photointerrupters in terms of their focal distances and focal depths.

④ Collector current versus slit width

Similar to sensing accuracy, the minimum size of



(a) GP2S01



(b) GP2S04

Fig. 63 Relative Collector Current vs. Distance

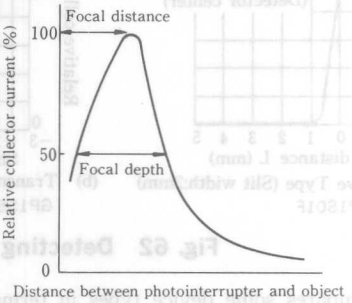
object detectable by a photointerrupter, or resolution, depends on the optical path width. In general, a higher sensing accuracy allows for a better resolution.

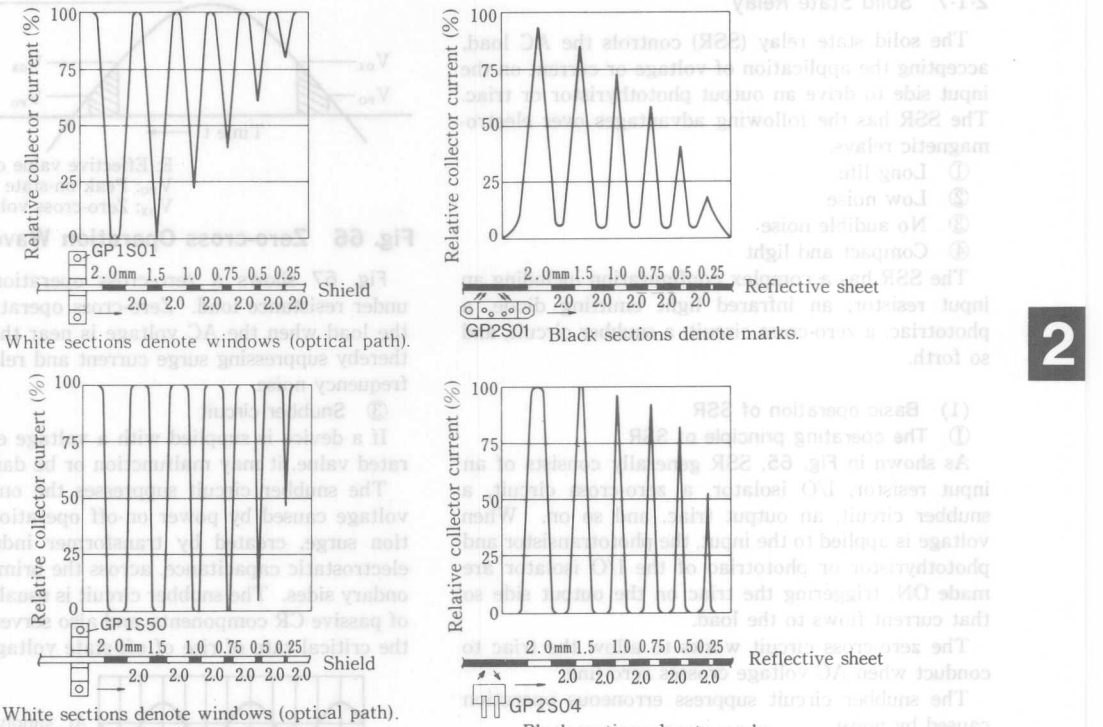
Fig. 64 shows relative collector current versus slit width. The figure reveals that the GP1S50 transmissive type photointerrupter has a higher resolution than the GP1S01. It also shows that the GP2S04 reflective type photointerrupter has a higher resolution than the GP2S01. It is necessary, therefore, to select a device type with a resolution that matches each application.

Table 7 Focal Distance and Depth of Reflective Type Photointerrupters

Item \ Model No.	GP2S01	GP2S04
Focal distance	4.2mm	0.8mm
Focal depth	5mm	1.7mm

Object: SHARP OMS TEST CARD





(a) Transmissive Type Photointerrupter (GP1S01, GP1S50)

(b) Reflective Type Photointerrupter (GP2S01, GP2S04)

Fig. 64 Relative Collector Current vs. Slit Width

2-1-7 Solid State Relay

The solid state relay (SSR) controls the AC load, accepting the application of voltage or current on the input side to drive an output photothyristor or triac. The SSR has the following advantages over electromagnetic relays.

① Long life
② Low noise
③ No audible noise
④ Compact and light

The SSR has a complex configuration including an input resistor, an infrared light emitting diode, a phototriac, a zero-cross circuit, a snubber circuit, and so forth.

(1) Basic operation of SSR

① The operating principle of SSR

As shown in Fig. 65, SSR generally consists of an input resistor, I/O isolator, a zero-cross circuit, a snubber circuit, an output triac, and so on. When voltage is applied to the input, the phototransistor and photothyristor or phototriac of the I/O isolator are made ON, triggering the triac on the output side so that current flows to the load.

The zero-cross circuit works to allow the triac to conduct when AC voltage crosses zero line.

The snubber circuit suppress erroneous operation caused by noise.

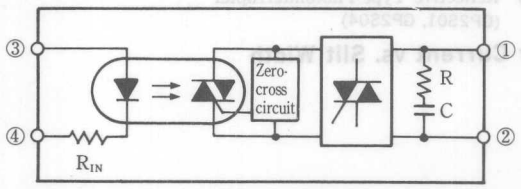


Fig. 65 Internal Connection Diagram of SSR(S112P11)

② Zero-cross operation

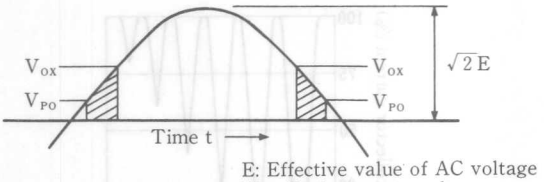
Some SSRs have a built-in zero-cross circuit.

Thin type of SSR is turned on at the neighbor of zero line (0V), and is turned off when the load current is reduced below the holding current of triac.

Fig. 66 shows a zero-cross operation waveform.

When the voltage across the SSR terminals (AC power supply side) is somewhere between V_{PO} and V_{OX}, application of an input voltage (DC signal side) turns on the SSR, causing a load current to flow. If the voltage at the output terminals is outside the range between V_{PO} and V_{OX}, applying an input voltage does not turn on the SSR.

The SSR is turned off when the load current is reduced below the holding current of triac because the load is controlled by the triac.



E: Effective value of AC voltage
V_{PO}: Peak on-state voltage
V_{OX}: Zero-cross voltage

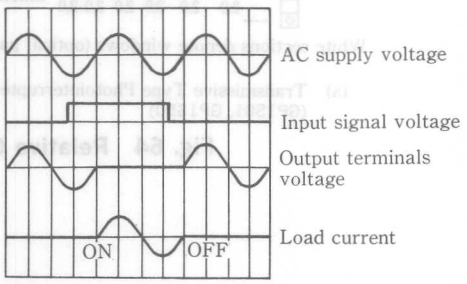
Fig. 66 Zero-cross Operation Waveform

Fig. 67 shows a zero-cross operation waveform under resistance load. Zero-cross operation turns on the load when the AC voltage is near the zero level, thereby suppressing surge current and relieving radio frequency noise.

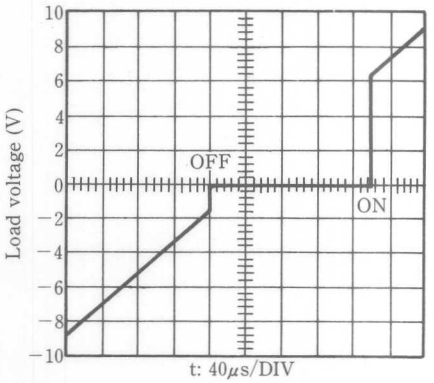
③ Snubber circuit

If a device is supplied with a voltage exceeding its rated value, it may malfunction or be damaged.

The snubber circuit suppresses the on-off impulse voltage caused by power on-off operation or oscillation surge, created by transformer inductance and electrostatic capacitance, across the primary and secondary sides. The snubber circuit is usually composed of passive CR components, and also serves to improve the critical rate of rise of off-state voltage (dv/dt).



(a)



(b)

Fig. 67 Zero-cross Operation Waveform under Resistance Load

(2) Classification

Table 8 shows the available SSR types.

SSRs are available with a current capacity of 1 to 16A and are used for direct load current.

They include the triac output type, snubber circuit built-in type, zero-cross circuit built-in type, and zero-cross and snubber circuits built-in type. The user can choose the best type according to load.

(3) Appearance and structures

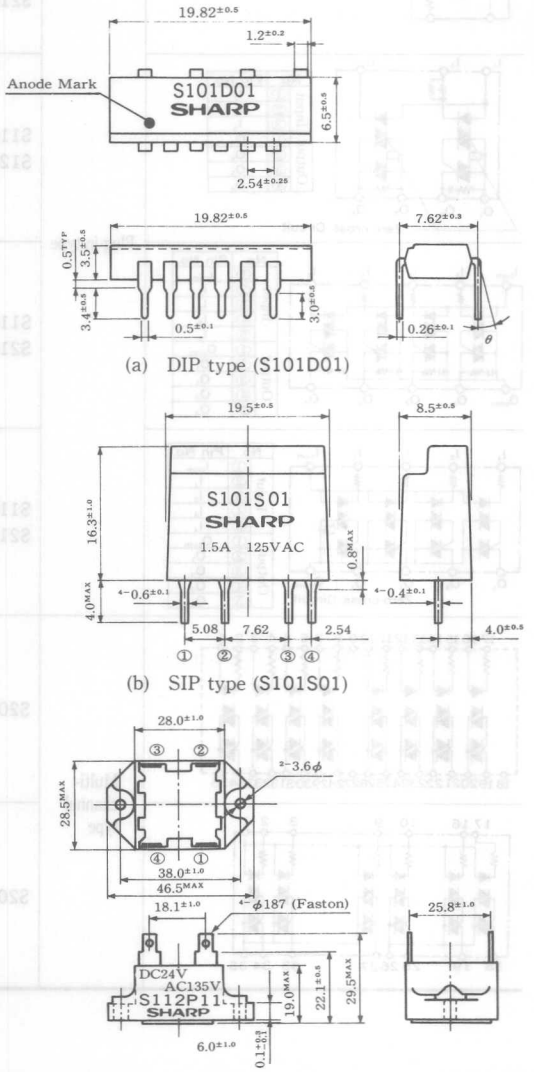
Since the SSRs handle a large current of 1 to 16A, package design places major stress on heat dissipation efficiency.

The S101D01 uses a lead frame (lead pin) buried in molded resin which dissipates heat from the photothyristor (Fig. 68(a)).

For the unit type SSRs, snubber such as SIP type, plug-in type, and multi-channel type, an I/O isolator, input current limiting resistor, zero-cross circuit, triac, and snubber circuit are mounted on PWB with a heat sink (radiation fin) and are made with non-flammable resin.

Table 8 Classification of SSRs

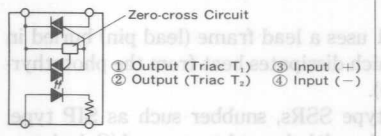
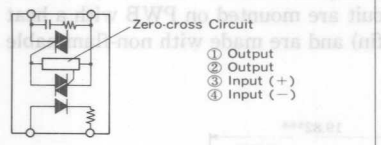
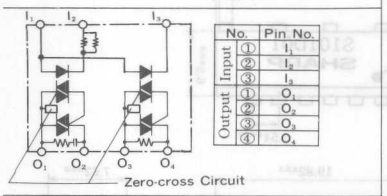
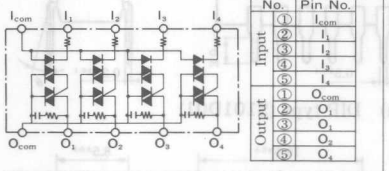
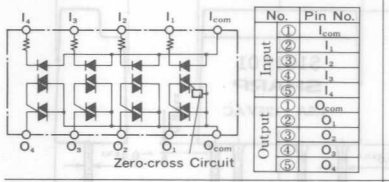
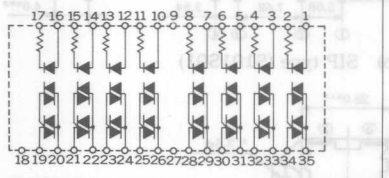
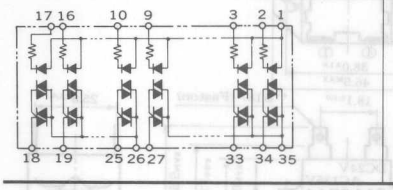
Internal connection diagram	Type	Typical model
② Anode ③ Cathode ④ NC ⑤ NC ⑥ NC ⑦ NC ⑨ Triac 1 ⑪ Triac 2 ⑬ Triac 1 ⑮ Gate ⑯ NC	DIP type	S101D01 S201D01
② Anode ③ Cathode ④ NC ⑤ NC ⑥ NC ⑦ NC ⑨ Triac 1 ⑪ Triac 2 ⑬ Triac 1 ⑮ Gate ⑯ NC Zero-cross Circuit		S101D02 S201D02
① Output (Triac T_1) ② Output (Triac T_2) ③ Input (+) ④ Input (−)		S101S01 S201S01
Zero-cross Circuit ① Output (Triac T_1) ② Output (Triac T_2) ③ Input (+) ④ Input (−)	SIP type	S101S02 S201S02
① Output (Triac T_1) ② Output (Triac T_2) ③ Input (+) ④ Input (−)		S101S03 S201S03

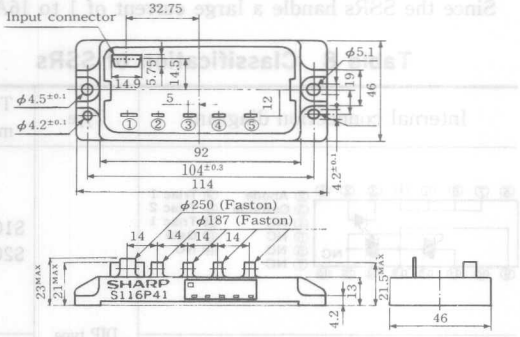


(a) DIP type (S101D01)

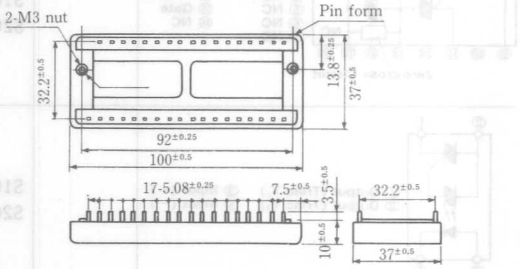
(b) SIP type (S101S01)

(c) Plug-in type (S112P11)

	SIP type	S101S04 S201S04
	Plug-in type	S112P11 S211P11 S116P11 S216P11
		S116P21 S1216P21
		S116P41 S216P41
		S116P42 S216P42
	Multi-channel type	S202D81
		S201DX1



(d) Plug-in type (S116P41)



(e) Multi-channel type (S202D81)

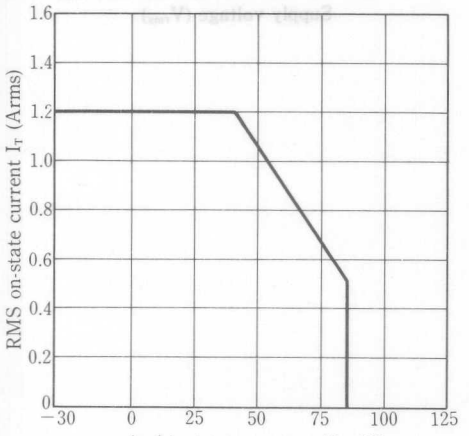
Fig. 68 Outline Dimensions of SSRs

(4) Electro-optical characteristics

① RMS on-state current versus ambient temperature

The junction temperature (T_j) of the component for SSR must always be below the maximum rated junction temperature (T_{jMAX}) by the method of cooling the SSR in using SSR. This is especially important to use power controlling thyristors or triacs with cooling measures. Because of their large internal power dissipation, they require special cooling measures to guarantee the rated specifications and designed operation life of the device.

When the ambient temperature of SSRs which require no heat sink is high, their RMS on-state current (I_T) should be reduced according to the RMS on-state current reduction curve.



(a) S101D01

Fig. 69(a) shows the RMS on-state current reduction curve for the S101D01. The allowable RMS on-state current for the S101D01 is 1.2Arms MAX. at Ta=85°C, and 0.8Arms MAX. at Ta=85°C.

The SSRs with heat sink (S112P11,etc.) must be designed so that T_j is always below T_{jMAX}. The thermal resistance of the heat sink is given using the following formula:

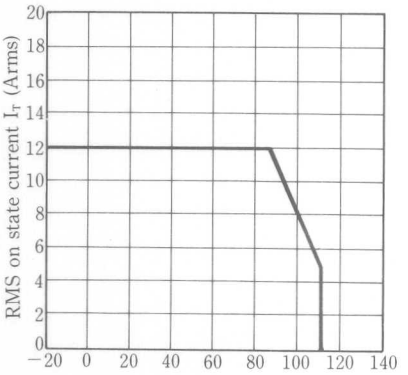
$$Rth=\frac{T_{jMAX}-Ta}{P}\ (°C/W)$$

Rth: Thermal resistance

P: Power dissipation in the internal of device

T_{jMAX}: Maximum rated junction temperature

Ta: Ambient temperature



(b) S112P11

Fig. 69 RMS On-state Current vs. Ambient Temperature (Case Temperature)

The total thermal resistance with the heat sink is given using the following formula:

$Rth(j-a)=Rth(j-c)+Rth(C-fin)+Rth(fin-a)$

When an alminium Al heat sink of 100×100×1mm is mounted on the S112P11, the thermal resistance is 8.5°C/W.

② Surge current versus power cycling

The maximum rating of surge current, such as overcurrent attributed to destroyed device or defective load is specified by far higher than the value for the maximum rated junction temperature for the device.

Therefore, surge current has a limit. It is limited by the number of cycling as shown in Fig. 70.

When using SSR, it is necessary to use fuse or breaker to protect the SSR against surge current.

③ Open circuit leak current

Fig. 71 shows the open circuit leak current characteristics of the S112P11.

Even when the circuit is off, a small quantity of leak current flows on the output side of the SSR.

It must be noted that CR of snubber circuit causes the open circuit leak current to increase, possibly resulting in malfunction of the SSR when driven with a small load.

④ Turn-on time (t_{on})

The t_{on} of SSR with built-in zero-cross circuit delays by a half cycle at maximum. Take account of this delay in designing circuit.

Fig. 70 Surge Current vs. Power Cycling (S112P11)

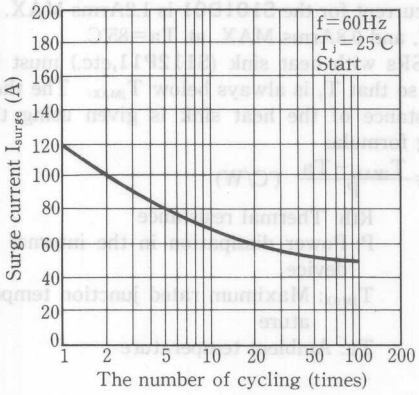
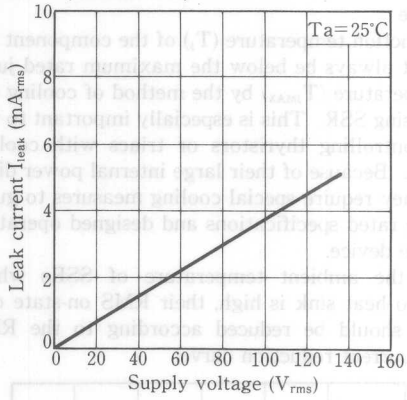


Fig. 71 Leak Current vs. Supply Voltage (S112P11)



2-2 Precautions for Use

2-2-1 Installation

(1) Installation on PWB

When mounting a device on a PWB whose pin-hole pitch dose not match the lead pin pitch of the device, reform the device pins appropriately so that the internal chip is not subjected to physical stress, as shown in Fig. 72 .

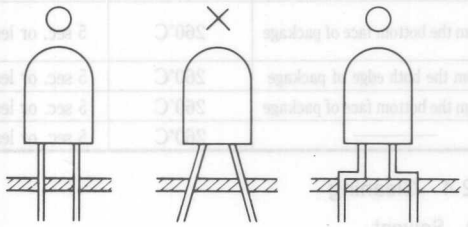


Fig. 72 Mounting a Device on a PWB

(2) Installation using a device holder

Light emitter and detecters are often mounted using a holder, as shown in Fig. 73. When using this method, make sure that there is no looseness between the device and holder. The device should also not be subjected to any undue stress because it may affect the device quality.

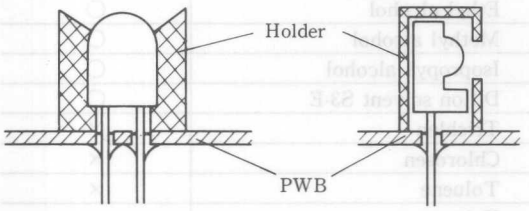


Fig. 73 Mounting a Device Using a Holder

(3) Installation using screws

When lead soldering is not adequate to securely retain a photointerrupter, it may be retained with screws.

The tightening torque should not exceed 6 kg · cm². Excessive tightening torque may deform the holder, which results in poor alignment of the optical axes and debrades perfomance.

2-2-2 Lead Forming

Lead pins should be formed before soldering. Do not apply forming stress to lead pins during or after soldering. For light emitter or detectors with lead frames, lead pins should be formed just beneath the tiebar cut section. For photocouplers or photointerrupters using dual-in-line packages, lead pins should be formed below the bent section so that forming stress does not affect the inside of the device (see Fig. 74). Stress to the resin may result in disconnection.

When forming lead pins, do not bend the same portion repeatedly or the pins may be broken.

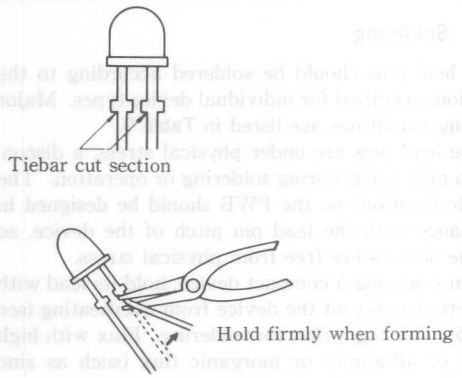


Fig. 74 Lead Forming Methods

Table 9 Soldering Conditions (Using a Soldering Iron)

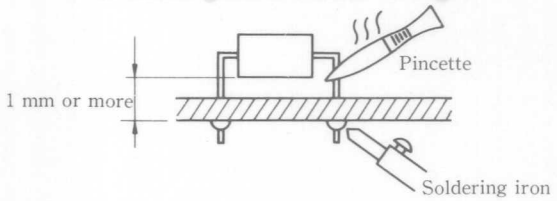
Classifications		Conditions	Soldering temperature	Soldering time
Light emitters/ Light detectors	Can package (GL514, PD153, PT501)	1.3mm from the bottom face of package	260°C	10 sec. or less
	Resin mold package (PT480/PT480F)	1.4mm from the bottom face of package	260°C	5 sec. or less
	Resin mold package (PD49PI/PD481PI)	2.3mm from the bottom face of package	260°C	10 sec. or less
	Resin mold package (GL360/GL527)	2.6mm from the bottom face of package	260°C	3 sec. or less
	Resin mold package (PT360/PT360F)	2.6 mm from the bottom face of package	260°C	5 sec. or less
Photocouplers	PC910	2mm from the bottom face of package	260°C	10 sec. or less
	All types other than the above	———	260°C	10 sec. or less
Photointerrupters	GP2S07	0.5mm from the both edge of package	260°C	5 sec. or less
	GP1L07, GP1S07, GP2L04, GP2S04, GP2S05	1mm from the bottom face of package	260°C	5 sec. or less
	GP2L06, GP2S06	2mm from the both edge of package	260°C	5 sec. or less
	GP2L09, GP2S09	4mm from the bottom face of package	260°C	5 sec. or less
	All types other than the above	———	260°C	5 sec. or less

2-2-3 Soldering

The lead pins should be soldered according to the conditions specified for individual device types. Major soldering conditions are listed in Table 9.

If the lead pins are under physical stress, a disconnection may occur during soldering or operation. The pin hole positions on the PWB should be designed in accordance with the lead pin pitch of the device, so that the devices are free from physical stress.

When soldering a compact device, hold its lead with a pincette to prevent the device from overheating (see Fig. 75). Use rogin flux for soldering. Flux with high acidity or alkalinity or inorganic flux (such as zinc coride) may cause lead corrosion.



When soldering with a soldering iron, hold the lead with a pincette to prevent the heat from flowing into the device.

Fig. 75 Soldering Method

2-2-4 Cleaning

(1) Solvent

In solvent used for cleaning, the resin surface of package may be damaged or the mark may disappear.

Table 10 shows the selection of solvent.

Referring to this table, use a suitable solvent for cleaning.

Table 10 Cleaning Solvents

Solvent name	Applicability
Freon TE	○
Freon TF	○
Ethyl alcohol	○
Methyl alcohol	○
Isopropyl alcohol	○
Diflon solvent S3-E	○
Trichlen	×
Chlorosen	×
Toluene	×
Xylene	×

〔Note〕 ① For the cleaning of stem type blue sensitive photodiode and subminiature resin mold type photointerrupter, etc., use only the alcohol base solvent.

② In selecting solvent, perform cleaning operation in actual cleaning conditions in advance, and check that no abnormality is found.

(2) Cleaning method

Table 11 shows the selection of cleaning method.

Table 11 Cleaning Methods

Cleaning method	Applicability	Remarks
Solvent	○	Solvent temperature: 45°C or less Dipping time: 3 min. or less (for transparent resin package type)
Ultrasonic cleaning	△	Prior to cleaning, clean the device in actual cleaning conditions in advance and check that no abnormality is found.
Brushing	×	The marking disappears. Damage occurs on the surface. (for transparent resin package type)
Steam cleaning	×	Since solvent activation is noticeable, it may swell transparent resin, causing damage to the device.

〔Note〕 The influence of ultrasonic cleaning upon the element differs, depending on the size of cleaning bath, ultrasonic output power, cleaning time, PWB size, installation method of the device and device mounting condition etc. therefore, clean the device in actual ultrasonic cleaning conditions in advance, and check that no abnormality is found, then clean the device. User should select fit condition that does not occur defect.

It should be noted that if you comes into contact with the device before solvent dries sufficiently after cleaning, the mark may disappear or the transparent resin surface may be damaged.

To reduce the stress the device receives, special consideration is required; for example, arrange the device so that it is shadowed by the oscillator or reduce the cleaning time.

2-2-5 External Disturbing Light

Some light detectors or photointerrupters feature a built-in visible light cut-off filter, which cuts off disturbing light with its wavelength of 700 nm or below, to prevent malfunctions due to disturbing light. Concerning these devices, be careful with the wavelengths of disturbing light.

The mini-flat type hybrid use photocoupler (PC219) and mini-flat type phototriac couplers require a shielded light measure by remolding*, etc.

*Remolding conditions for the PC219 and mini-flat type phototriac couplers:

The PC219 and mini-flat type phototriac couplers employ an epoxy resin package. For remolding, use an epoxy resin with a hardening temperature of lower than 150°C and a hardening time of less than 2 hours.

2-2-6 Dust and Dirt

If the surface or the slits of a photointerrupter are contaminated with dust or dirt, it may malfunction. Caution should be taken to avoid this.

2-3 Terms and Symbols

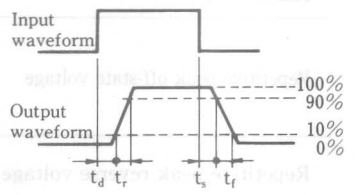
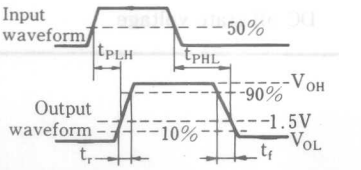
⟨1⟩ General

Term	Symbol	Definition
Absolute maximum ratings	—	Maximum ratings which should never be exceeded under any operating or testing conditions
Ambient temperature	T_a	Ambient temperature of a semiconductor device
Case temperature	T_c	Temperature at a specified spot of the case of a semiconductor device
Operating temperature	T_{opr}	Ambient temperature at which a semiconductor device is to be operated
Storage temperature	T_{stg}	Temperature at which a semiconductor device can be stored without any deterioration of performance under no voltage applied
Soldering temperature	T_{sol}	Soldering temperature at which the specified spot on terminals may be soldered for a specified period of time without causing deterioration of the performance of a semiconductor device

⟨2⟩ Infrared Light Emitting Diode

Term	Symbol	Definition
Diode power dissipation	P	Allowable power dissipation across the anode and cathode
Forward current	I_F	DC current passing across the anode and cathode in the forward direction
Peak forward current	I_{FM}	Maximum instantaneous value of forward current
Forward voltage	V_F	Voltage drop across the anode and cathode caused by forward current
Peak forward voltage	V_{FM}	Maximum instantaneous value of the voltage drop across the anode and cathode resulting from peak forward current
Reverse current	I_R	DC current passing across the anode and cathode in the reverse direction
Reverse voltage	V_R	DC voltage applied across the anode and cathode in the reverse direction
Terminal capacitance	C_t	Electrostatic capacity across the anode and cathode terminals
Radiant flux	Φ_e	Radiant energy emitted in a unit time
Peak emission wavelength	λ_p	Wavelength at which radiant intensity is maximized
Half intensity wavelength	$\Delta\lambda$	Range of wavelength of spectral distribution in which the radiant intensity is no less than one half the maximum intensity
Half intensity angle	$\Delta\theta$	Range of beam angle in which the radiant intensity is no less than one half that on the front optical axis

〈3〉 Photodiode and Phototransistor

Term	Symbol	Definition
Collector-emitter voltage	V_{CEO}	DC voltage applied across the collector and emitter with base terminal left open
Emitter-collector voltage	V_{ECO}	DC voltage applied across the emitter and collector with base terminal left open
Collector-base voltage	V_{CBO}	DC voltage applied across the collector and base with emitter terminal left open
Emitter-base voltage	V_{EBO}	DC voltage applied across the emitter and base with collector terminal left open
Reverse voltage	V_R	DC voltage applied across the anode and cathode in the reverse direction
Collector power dissipation	P_C	Power dissipation allowed for the collector
Diode power dissipation	P	Power dissipation allowed across the anode and cathode
Collector current	I_C	DC current passing through the collector electrode under a specified input condition
Photocurrent	I_P	Current passing through the electrode under a specified input condition
Short circuit current	I_{SC}	Current passing across the shorted terminals of a photodiode under the presence of incident light
Open circuit voltage	V_{OC}	Electromotive force appearing across a photodiode when it is exposed to light
Collector dark current	I_{CEO}	Collector current occurring when a reverse voltage is applied across the collector and emitter with base terminal left open
Dark current	I_d	Current passing through a photodiode when a reverse voltage is applied under no incident light
Illuminance	E_V	Luminous flux incident to a unit area of a surface
Irradiance	E_e	Radiant flux incident to a unit area of a surface
Threshold illuminance	E_{VLH} E_{VHL}	Incident light illuminance at which the output goes from Low to High or High to Low
Dark current temperature coefficient	α_T	Rate at which dark current varies with ambient temperature
Short circuit current temperature coefficient	β_T	Rate at which short circuit current varies with ambient temperature
DC current amplification factor	h_{FE}	DC current amplification factor of emitter common circuit
Collector emitter saturation voltage	$V_{CE(sat)}$	DC voltage applied across the collector and emitter which causes a specified saturation state
Terminal capacitance	C_t	Electrostatic capacity across the anode and cathode
Peak sensitivity wavelength	λ_P	Wavelength of incident light at which sensitivity is maximized
Half sensitivity angle	$\Delta\theta$	Range of angle in which the sensitivity is no less than one half that of peak value
Cut-off frequency	f_c	Frequency at which the amplitude of AC fundamental wave of an output parameter falls by 3 dB when the frequency of an input parameter having a constant amplitude of sine wave is varied
Response time		Output response to the rising and falling edges of an input square wave signal. The definitions of response times are as follows: Rise time: t_r Delay time: t_d Fall time: t_f Storage time: t_s Turn-on time: $t_{on}=t_d+t_r$ Turn-off time: $t_{off}=t_s+t_f$ "Low→High" propagation time: t_{PLH} "High→Low" propagation time: t_{PHL}  

⟨4⟩ Photocoupler and Photointerrupter

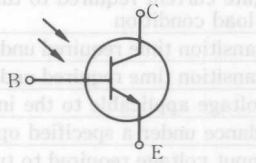
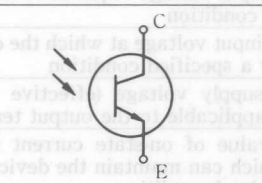
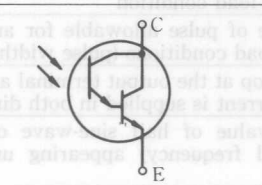
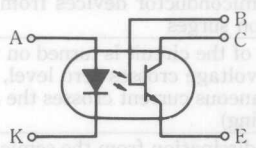
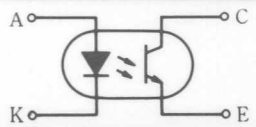
Term	Symbol	Definition
Total power dissipation	P_{tot}	Power dissipation allowable for the entire circuits between input and output
Isolation voltage	V_{iso}	Maximum AC voltage which isolation between the input and output is guaranteed (effective value)
Isolation resistance	R_{ISO}	Resistance across isolated input and output terminals at a specified application voltage
Current transfer ratio	CTR	Ratio of output current to input current: $CTR=(I_C/I_F)\times 100\%$
Reflection signal ratio	S/M	Ratio of an output signal caused by reflection from spaces on a test sheet to that caused by reflection from marks on it
Leak current	I_{LEAK}	DC current passing through the collector terminal under a specified condition (without reflective object)
Threshold input current	I_{FLH} I_{FHL}	Input current at which the output level goes from Low to High or High to Low
Low level output voltage	V_{OL}	Output voltage appearing when a specified Low level current appears at the output terminal
High level output voltage	V_{OH}	Output voltage appearing when a specified High level current appears at the output terminal
Low level output current	I_{OL}	Output current appearing when a specified Low level output voltage is applied to the output terminal
High level output current	I_{OH}	Output current appearing when a specified High level output voltage is applied to the output terminal
Low level supply current	I_{CCL}	Supply current required when the output is at Low level
High level supply current	I_{CCH}	Supply current required when the output is at High level
Hysteresis	I_{FLH}/I_{FHL} I_{FHL}/I_{FLH}	Ratio of the input threshold current that causes the output level to go from Low to High or High to Low
Floating capacitance	C_f	Electrostatic capacity across input and output terminals
Common mode rejection ratio	CMR	Ratio of variations of output noise voltage to that of input-output voltage

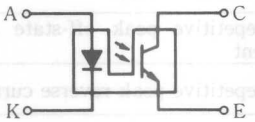
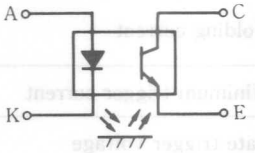
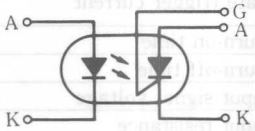
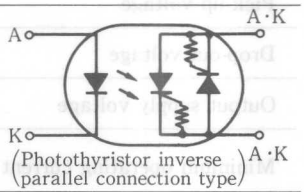
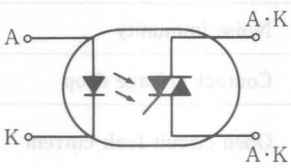
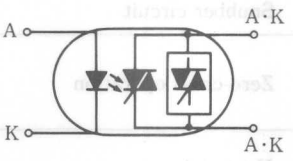
⟨5⟩ Solid State Relay

Term	Symbol	Definition
RMS on-state current	I_T	Effective value of continuous forward on-state current which is allowed under a specified condition
Peak one cycle surge current	I_{surge}	Peak value of forward half sine-wave on-state current (with commercial frequency) which is allowed only for one cycle when the junction is at the maximum rated temperature
Rated $\int i_T^2dt$	$\int i_T^2dt$	Integration of square half sine-wave of the rated surge current, over a period of half cycle
Repetitive peak off-state voltage	V_{DRM}	Peak value of forward half sine-wave voltage (with commercial frequency) which can maintain the thyristor in the off state when a repetitive forward voltage is applied across the anode and cathode under a specified temperature and gate conditions
Repetitive peak reverse voltage	V_{RRM}	Peak value of repetitive reverse half sine-wave voltage (with commercial frequency) applicable across the anode and cathode under specified temperature and gate conditions
DC off-state voltage	V_D	Continuous forward DC voltage, applied across the anode and cathode, which can maintain the thyristor in the off state under specified temperature and gate condition

Term	Symbol	Definition
Critical rate of rise of on-state current	di/dt	Maximum on-state current rise rate allowable for a thyristor which is being switched from off to on state under specified temperature and gate conditions
Critical rate of rise of off-state voltage	dv/dt	Maximum forward-voltage rise rate which will not cause a thyristor to be turned from off to on under a specified condition
Repetitive peak off-state current	I_{DRM}	Current resulting from repetitive peak off-state voltage applied in the off state
Repetitive peak reverse current	I_{RRM}	Current resulting from repetitive peak reverse voltage applied
On-state voltage	V_T	Voltage drop across the anode and cathode resulting from a specified forward DC current supplied under on state
Holding current	I_H	Minimum on-state current required to maintain a thyristor in the on state after it was turned on under specified temperature, gate, and load conditions
Minimum trigger current	I_{FT}	Minimum input current required to turn on a thyristor under a specified condition
Gate trigger voltage	V_{GT}	Minimum gate voltage required to turn on a thyristor under specified temperature and load conditions
Gate trigger current	I_{GT}	Minimum gate current required to turn on a thyristor under a specified load condition
Turn-on time	t_{on}	Off-to-on transition time required under a specified condition
Turn-off time	t_{off}	On-to-off transition time required under a specified condition
Input signal voltage	V_{IN}	Range of voltage applicable to the input terminal
Input resistance	R_{IN}	Input impedance under a specified operating condition
Pick-up voltage	—	Minimum input voltage required to turn on the device under a specified condition
Drop-out voltage	—	Maximum input voltage at which the device is kept in the off state under a specified condition
Output supply voltage	—	Range of supply voltage (effective value) of commercial frequency applicable to the output terminal
Minimum operating current	—	Effective value of on-state current (with commercial frequency) which can maintain the device in the on state under a specified load condition
Noise immunity	—	Peak value of pulse allowable for an SSR under specified gate and load conditions (pulse width: 1μs, rise time: 1ns)
Contact voltage drop	—	Voltage drop at the output terminal appearing when a specified AC current is supplied in both directions under on state
Open circuit leak current	I_{leak}	Effective value of half sine-wave off-state current (with commercial frequency) appearing under a specified load condition
Snubber circuit	—	Protects semiconductor devices from switch on-off inpulses or oscillation surges
Zero-cross operation	—	The output of the circuit is turned on when the instantaneous AC supply voltage crosses zero level, and is turned off when the instantaneous current crosses the zero current level (zero volt switching)
Heat sink	—	Helps heat dissipation from the semiconductor device so that its junction temperature does not exceed the rated temperature

2-4 Schematic Drawings

Type	Schematic Drawing
Light Emitting Diode	
Photodiode	
Phototransistor (With base terminal)	
Phototransistor (Without base terminal)	
Phototransistor (Darlington type)	
Photocoupler (With base terminal)	
Photocoupler (Without base terminal)	

Type	Schematic Drawing
Photointerrupter (Transmissive type)	
Photointerrupter (Reflective type)	
Photothyristor Coupler	
Phototriac Coupler	 
Solid State Relay	

2-5 Quality and Reliability Test Data

2-5-1 Quality Assurance System

SHARP's optoelectronic products are widely used for industrial, business, and home applications, such as in floppy disk drives, copiers, printers, and VCR's.

In addition to their expanding application range, optoelectronic devices are now finding a greater number of applications in each product. In fact, hundreds of such devices can be used in just one product. Customer demands for product quality are also increasing.

To meet these market needs, SHARP dedicates itself to ensuring product quality. We adopt quality assurance concepts in the planning, engineering and production and maintenance of all products through a variety of reliability tests and strict inspections. Some of these quality assurance activities are described below.

Fig. 76 shows our quality assurance system.

Our quality and reliability assurance activities are based on the following philosophy.

1) All employees are involved in quality assurance, making each other aware of importance of quality control.
2) Reliability is an important part of engineering new products.
3) Quality and reliability control involves not only pro-

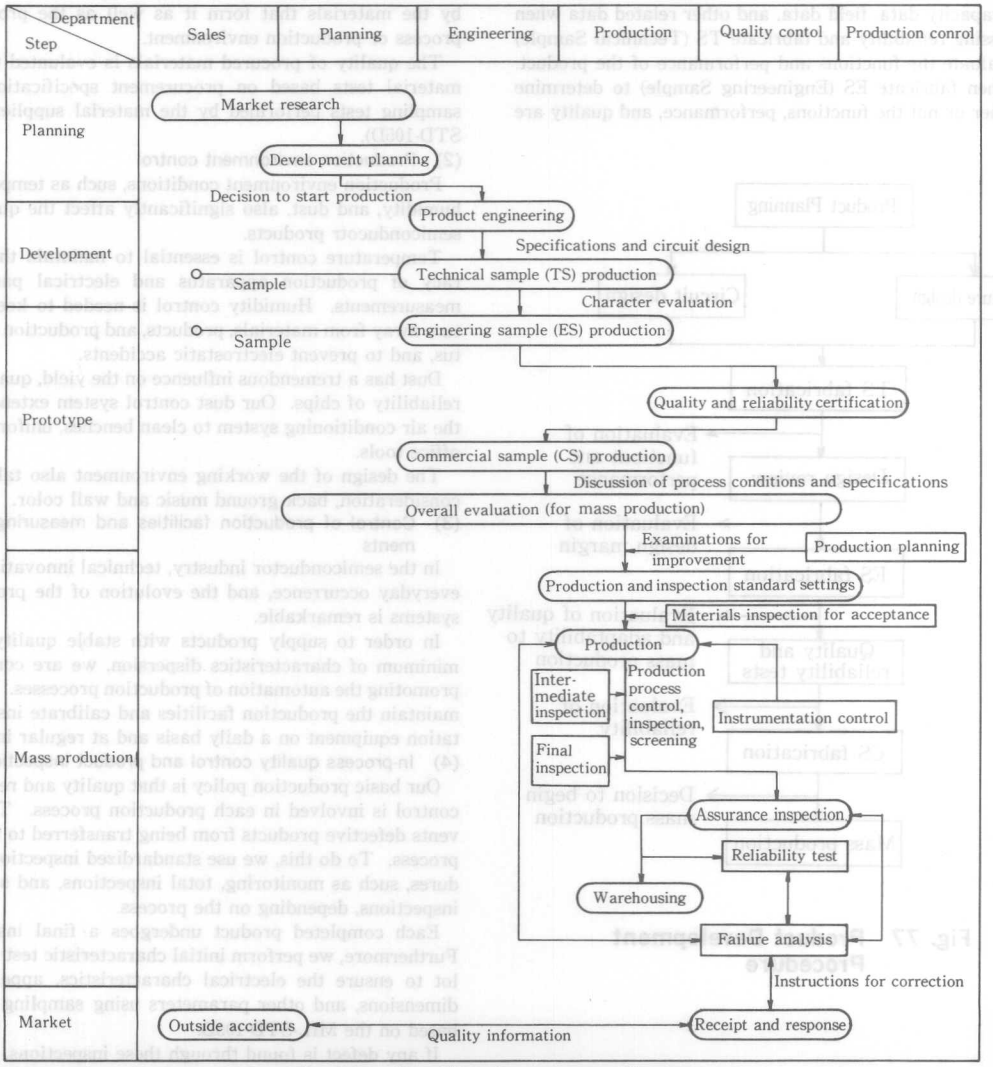


Fig. 76 Quality Assurance System

duction processes, but also the production environment, materials, facilities, and measuring instruments.

4) Long-term reliability is checked through reliability tests, and its limits are identified through the same test.

5) Data obtained through process inspection, reliability tests, and market research is constantly fed back to the quality control process.

2-5-2 Quality and Reliability Control during New Product Development

The development of a new product begins with determining the product specifications and quality that meet the customer's needs and the creation of a development plan regarding product price, quantity, marketing timing, and so forth.

In the product design stage, we use research data, production capacity data, field data, and other related data when discussing reliability and fabricate TS (Technical Sample) to evaluate the functions and performance of the product. We then fabricate ES (Engineering Sample) to determine whether or not the functions, performance, and quality are guaranteed in actual prduction conditions. We also use the ES for quality and reliability testing to evaluate long-term reliability.

Finally, we evaluate the adaptability of the design to mass production using CS (Commercial Sample) obtained through trial mass production.

Upon completion of the design process (before ES fabrication), we perform a design review (DR) to ensure that the quality and reliability meet the customer's needs. We also check for the appropriate design margin.

Product development flows as shown in Fig. 77.

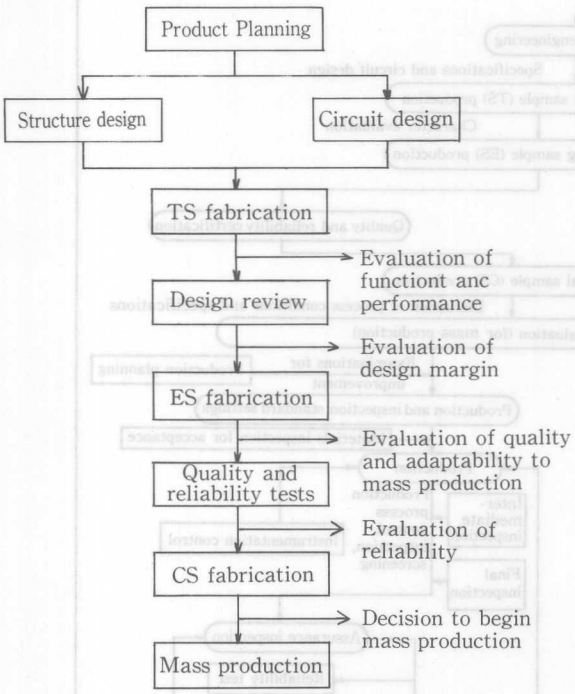


Fig. 77 Product Development Procedure

2-5-3 Quality and Reliability Control for Mass Production

(1) Material quality control

The quality and reliability of a product is greatly affected by the materials that form it as well as the production process or production environment.

The quality of procured materials is evaluated through material tests based on procurement specifications and sampling tests performed by the material supplier (MIL-STD-105D).

(2) Production environment control

Production environment conditions, such as temperature, humidity, and dust, also significantly affect the quality of semiconducotr products.

Temperature control is essential to maintain the accuracy of production apparatus and electrical parameter measurements. Humidity control is needed to keep moisture away from materials, products, and production apparatus, and to prevent electrostatic accidents.

Dust has a tremendous influence on the yield, quality and reliability of chips. Our dust control system extends from the air conditioning system to clean benches, uniforms, and office tools.

The design of the working environment also takes into consideration, back ground music and wall color.

(3) Control of production facilities and measuring instruments

In the semiconductor industry, technical innovation is an everyday occurrence, and the evolution of the production systems is remarkable.

In order to supply products with stable quality and a minimum of characteristics dispersion, we are constantly promoting the automation of production processes. We also maintain the production facilities and calibrate instrumentation equipment on a daily basis and at regular intervals.

(4) In-process quality control and product inspection

Our basic production policy is that quality and reliability control is involved in each production process. This prevents defective products from being transferred to the next process. To do this, we use standardized inspection procedures, such as monitoring, total inspections, and sampling inspections, depending on the process.

Each completed product undergoes a final inspection. Furthermore, we perform initial characteristic test for each lot to ensure the electrical characteristics, appearances, dimensions, and other parameters using sampling method based on the MIL-STD-105D.

If any defect is found through these inspections, we analyze the cause of the defect and take necessary action to

correct it. We then return the analysis results to the engineering and production sections to prevent regeneration of the same defects.

Table 12 shows an example of in-process quality control for photocouplers.

(5) Assurance of reliability

To ensure long-term products reliability, we select product samples at regular intervals and subject the sample to reliability tests such as life tests and environmental tests.

Whenever a production process has been altered, we perform a reliability test to check the new process for long-term reliability.

2-5-4 Reliability Test

In addition to the reliability assurance level check mentioned above, we also perform reliabilty tests to identify the design limit and destructive failure modes, and to predict the field reliability of products.

Reliabilty tests are roughly classified into durability, thermal environment, and mechanical tests. The test methods used are specified in the Japan Industrial Standards (JIS), the Standards of the Elecoronic Industry Association of Japan (EIAJ), the U.S. MIL Standards (MIL), and some others. We use our own standardized test methods in accordance with these institutionalized standards.

Table 12 In-process Quality Control for Photocouplers

Production process	Controlled item	Purpose
Material procurement		
Material acceptance check	Bonding performance, appearance, viscosity, plasticity	Ensuring bonding performance and material quality check
Die bonding	Amount of paste	Die bonding control
Wire bonding	Temperature and load	Wire bonding control
Inspection of wire bonding result	Bonding location, shape, wire loop, strength	Die and wire bonding check
Precoating	Hardening temperature and time, amount of resin	Infrared LED chip protection
Primary molding	Molding temperature and pressure	Molding control
Secondary molding	Molding temperature and pressure	Molding control
Plating	Plating time and temperature, and plating liquid concentration	Control of plated layer thickness
Forming	Dimensions and protruded resin	Appearance control
Electrical inspection	Electro-optical characteristics	(Total inspection)
Marking	Ink viscosity	Marking durability control
Appearance inspection	Marking, void, plating	(Total inspection)
Packing	Quantity inspection	
Delivery inspection	Electrical and appearance inspection	(Sampling lot inspection)
Warehousing		

Table 13 Reliability Test

Test	Test item	Test condition	Purpose
Durability	High temperature storage	T_{stg} (MAX.)	Evaluates product durability after long-term storage at high temperature.
	High temperature operation	T_{opr} (MAX.) Current · Voltage (MAX.)	Evaluates prodcut durability against long-term thermal and electrical stresses.
	High temperature high humidity storage	60°C RH=90% 85°C RH=85% * Pressure cooker 120°C, double atmospheric pressure*	Evaluates durability in long-term, high temperature high humidity storage.
	High temperature reverse bias	T_{opr} (MAX.) Isolation voltage (MAX.)	Evaluates durability against long-term thermal, humidity, and electrical stresses.
	Low temperature storage	T_{stg} (MIN.)	Evaluates product durability following long-term strage in low temperature.
Thermal environment	Temperature cycle	T_{stg} (MAX.)~T_{stg} (MIN.)	Evaluates product durability against sudden temperature variations.
	Thermal shock	0°C~+100°C (liquid phase)	Evaluates durability against sudden temperature variations.
	Temprature and humidity cycle	−10°C~+65°C RH=90%	Evaluates durability against temperature variations in high humidity
	Soldering heat resistance	260°C 10s	Evaluates resistance to thermal stress caused by soldering.
Mechanical	Mechanical shock	1500G, 0.5ms ±X, ±Y, ±Z	Evaluates structural and mechanical resistance to serve mechanical shock.
	Variable frequency vibration	20G, 20~2,000Hz, X, Y, Z	Evaluates resistance to vibrations during transit or operation.
	Terminal strength	Tensile strength: constant load, Bend strength: constant load; bent 90 degrees in both directions once. (Load and loading duration depends on the sectional area of the terminal.)	Evaluates durability against mechanical stress applied to terminals.
	Hermetic seal performance	Micro-leak by helium gas, Large leak by bubble	Evaluates the air-tight performance of hermetically sealed packages.
	Salty water	Soaked in 5% salt solution, Ta=35°C, 24hr	Evaluates corrosion-proof performance in salty water.
	Solderability	230°C for 5 seconds (with flux)	Evaluates the solderability of terminals.
	Solution-proof performance	Soaked in isopropy alcohol, Ta=25°C, 30 sec.	Evaluates the solution-proof performance of markings.

* Except for infrared LEDs, light detectors, and photointerrupters.

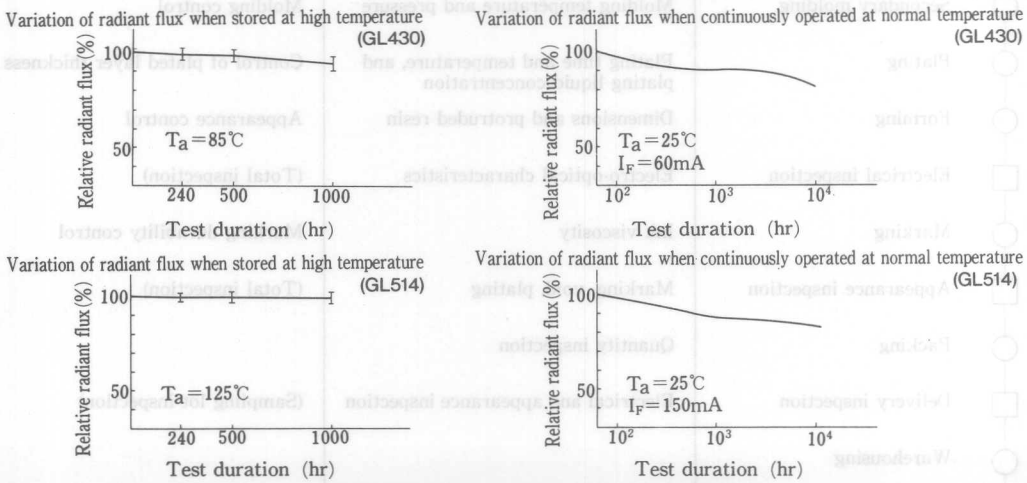


Fig. 78 Reliability Test Data (Infrared Light Emitting Diode)

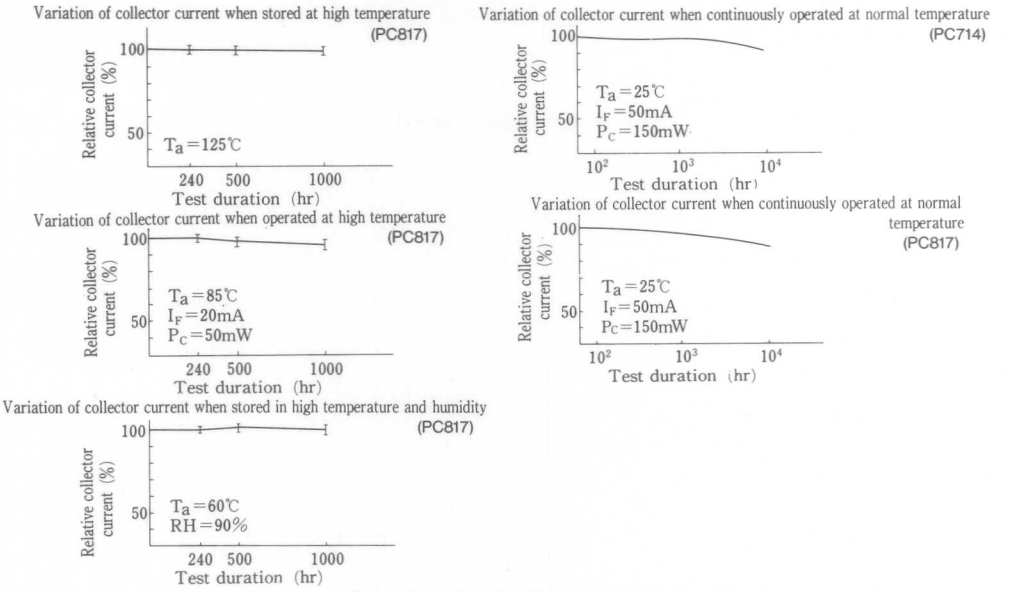


Fig. 79 Reliability Test Data (Photocoupler)

Table 13 shows a typical reliability test.

Of the durability tests on semiconductor products, we place major emphasis on the high temperature operation test. For plastic-molded semiconductor devices, we place special importance on the high temperature, high humidity storage (operation) tests.

Fig. 78 and 79 show typical relability test data.

2-5-5 Maintenance

If a device fails after delivery, we request you to return the defective device to us for failure analysis. We may ask you for details regarding the operating conditions, the failure rate, symptoms, etc.

Once the cause of failure is tracked down, the result is fed back to the engineering production and usage stages to avoid recurrence of the failure, and is also submitted to the customer in the form of a report.

Failure in the field and information about quality is essential for improving product reliability. We make great efforts to acquire and utilize this type of information.

Fig. 80 shows how failures in the field are processed.

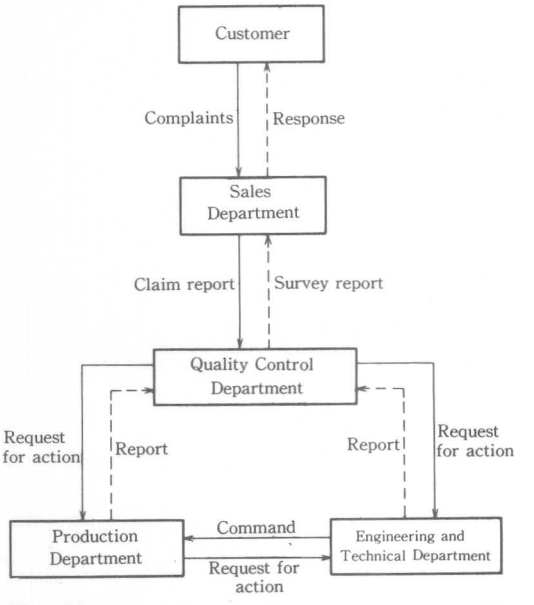


Fig. 80 Processing of Failures Reported in the Field

2-5-6 Safety Standards

The safety standards for electrical products include the domestic Electrical Appliances Regulational Act of Japan, the UL Standards in the United States, the TÜV Standards in West Germany, and many others.

Since our photocouplers and solid state relays were approved by the UL standards in 1977, all of our major semiconductor products have acquired the UL approval.

Many of our products also gained the TÜV approval of West Germany in November of 1982. We will continue our effort to gain TÜV and other safety standards approval for all of our semiconductor products.

Fig. 79 Reliability Test Data (Photocoupler)

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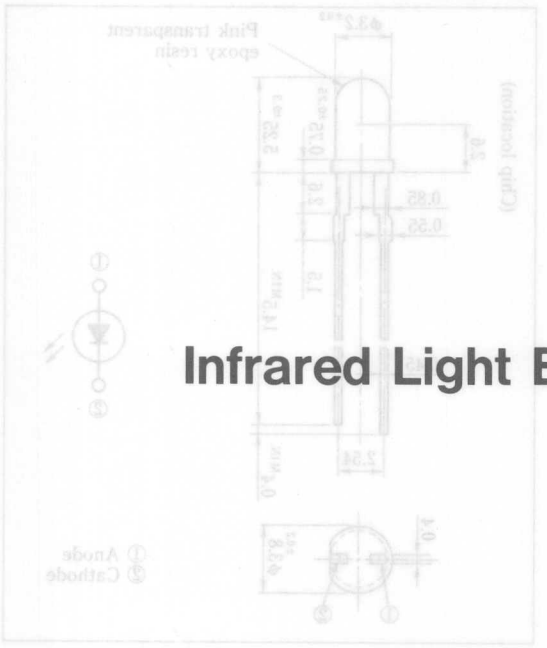
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Infrared Light Emitting Diodes

3



GL360 ϕ3.2mm Resin Mold Type Infrared Light Emitting Diode

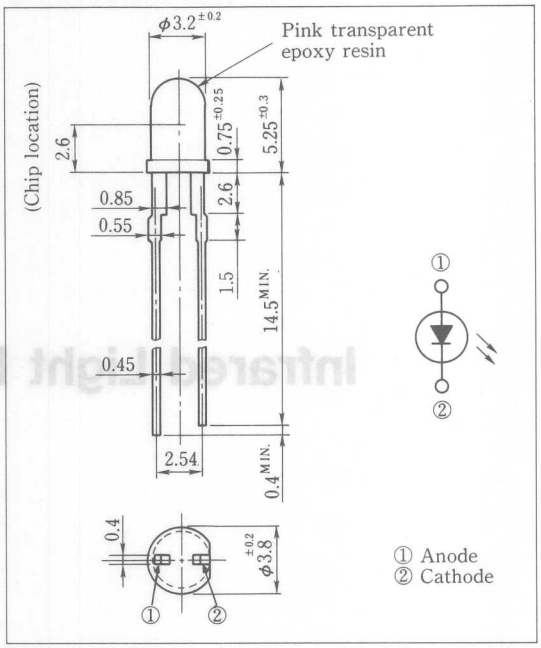
■ Features

1. ϕ3.2mm epoxy resin package
2. Intermediate beam angle ($\Delta\theta$: TYP. $\pm$20°)
3. High output (Φ_e: MIN.1.5mW at I_F=40mA)

■ Applications

1. Floppy disk drives
2. Optoelectronic switches
3. Infrared applied systems

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta = 25℃)

Parameter	Symbol	Rating	Unit
Power dissipation	P	90	mW
Forward current	I_F	60	mA
*1Peak forward current	I_{FM}	1	A
Reverse voltage	V_R	3	V
Operating temperature	T_{opr}	−25～+85	℃
Storage temperature	T_{stg}	−40～+85	℃
*2Soldering temperature	T_{sol}	260	℃

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds at the position of 2.6mm from the bottom face of resin package.

■ Electro-optical Characteristics (Ta=25℃)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_F	I_F=40mA	—	1.3	1.5	V
Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	2.2	3.5	V
Reverse current	I_R	V_R=3V	—	—	10	μA
Terminal capacitance	C_t	V=0, f=1MHz	—	70	—	pF
*3Radiant intensity	I_E	I_F=40mA	2.5	5.0	10.0	mW/sr
Radiant flux	Φ_e	I_F=40mA	1.5	2.4	—	mW
Peak emission wavelength	λ_p	I_F=40mA	—	950	—	nm
Half intensity wavelength	$\triangle\lambda$	I_F=40mA	—	45	—	nm

*3 I_E : Value obtained by converting the value in power of radiant fluxes emitted at the solid angle of 0.01 sr (steradian) in the direction of mechanical axis of the lense portion into 1 sr of all those emitted from the light emitting diode.

Fig. 1 Forward Current vs. Ambient Temperature

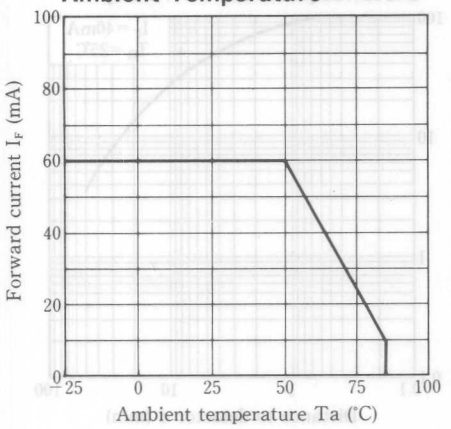
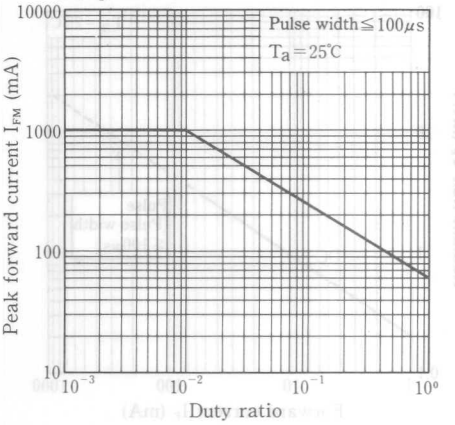


Fig. 2 Peak Forward Current vs. Duty Ratio



3

Fig. 3 Spectral Distribution

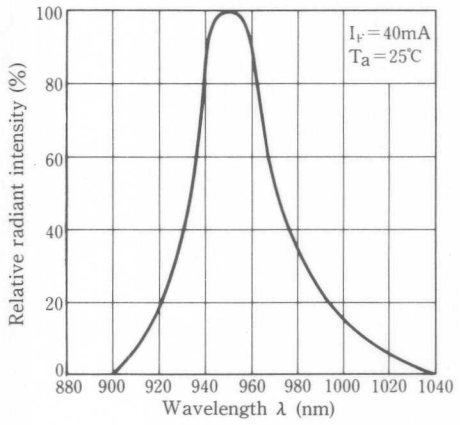


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

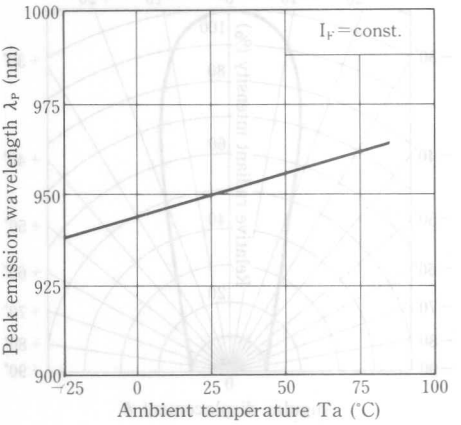


Fig. 5 Forward Current vs. Forward Voltage

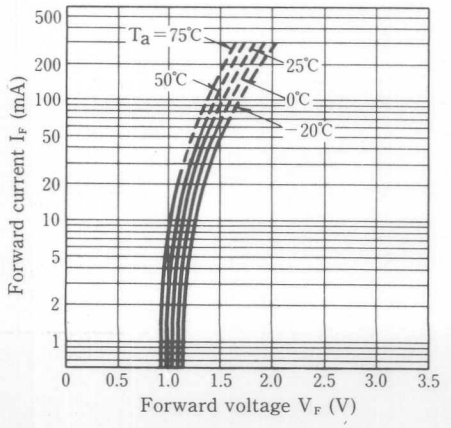


Fig. 6 Relative Radiant Flux vs. Ambient Temperature

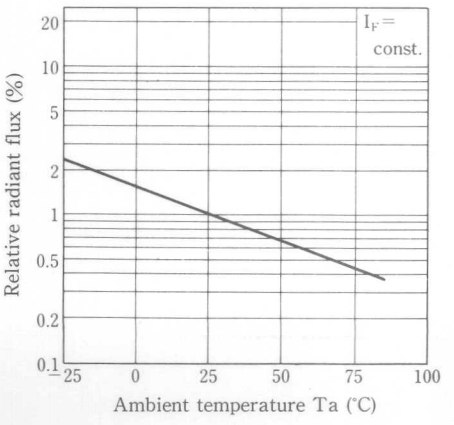


Fig. 7 Radiant Flux vs. Forward Current

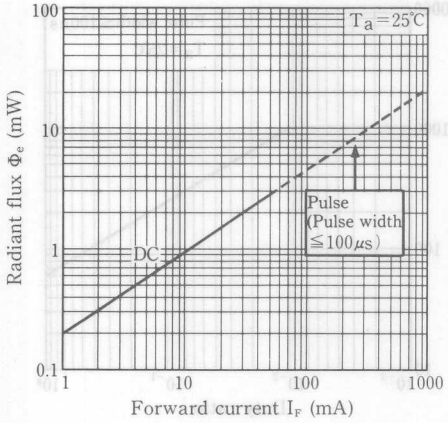


Fig. 8 Relative Collector Current vs. Distance(Detector: PT360)

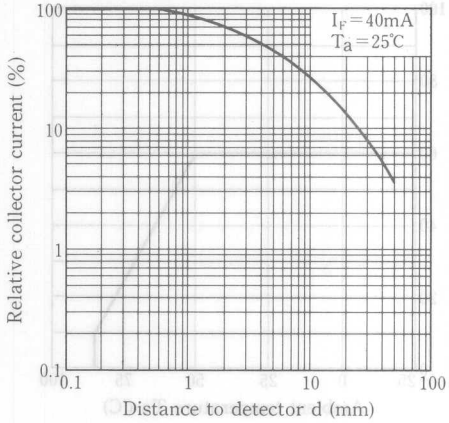
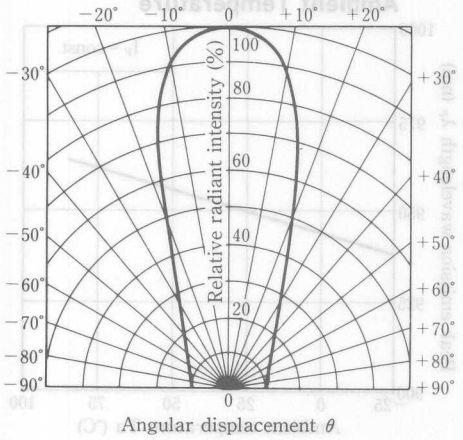


Fig. 9 Radiation Diagram (Ta=25°C)



GL371/GL372 Compact Resin Stem Type Infrared Light Emitting Diode

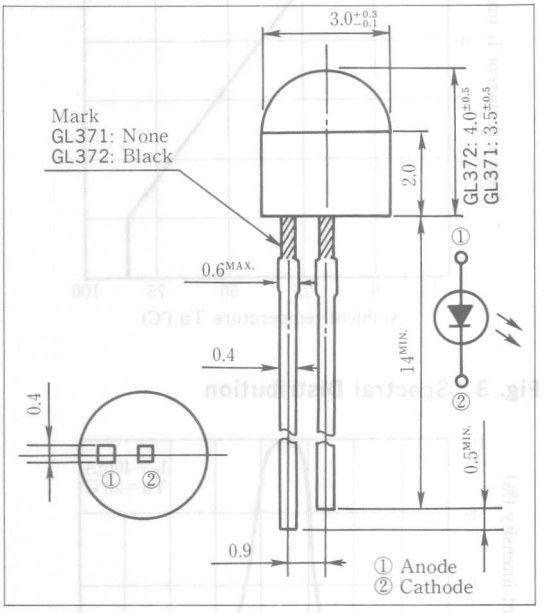
■ Features

1. ϕ3mm compact, resin stem type
2. Wide beam angle (GL371 $\Delta\theta$: TYP. $\pm 90°$ / GL372 $\Delta\theta$: TYP. $\pm 70°$)
3. High output
   (Φ_e: MIN. 1.7mW at I_F=40mA)

■ Applications

1. Floppy disk drives
2. Smoke detectors, optoelectronic switches
3. Infrared applied systems

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	75	mW
Forward current	I_F	50	mA
*1Peak Forward current	I_{FM}	1	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−25～+85	°C
*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds at the position of 1.5mm from the bottom face of resin package.

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage		V_F	I_F=40mA	—	1.3	1.6	V
Peak forward voltage		V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
Reverse current		I_R	V_R=3V	—	—	10	μA
Terminal capacitance		C_t	V_R=0, f=1MHz	—	50	—	pF
Frequency response		f_c		—	300	—	kHz
Radiant flux	GL371	Φ_e	I_F=40mA	1.7	3.3	—	mW
	GL372			1.7	3.3	—	mW
Peak emission wavelength		λ_p	I_F=40mA	—	950	—	nm
Half intensity wavelength		$\Delta\lambda$	I_F=40mA	—	45	—	nm
Half intensity angle	GL371	$\Delta\theta$	I_F=40mA	—	±90	—	deg.
	GL372			—	±70	—	deg.

Fig. 1 Forward Current vs. Ambient Temperature

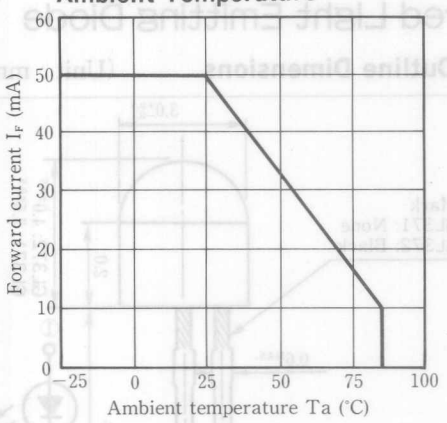


Fig. 2 Peak Forward Current vs. Duty Ratio

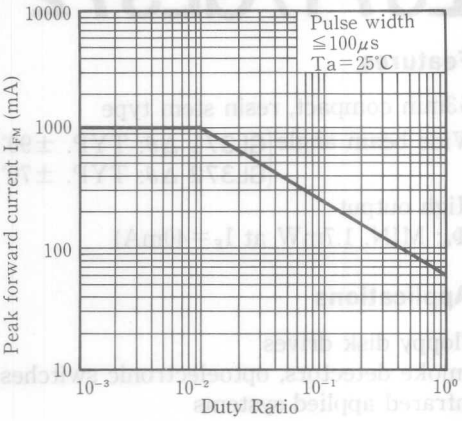


Fig. 3 Spectral Distribution

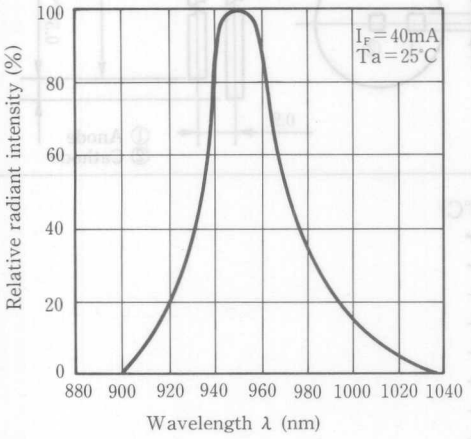


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

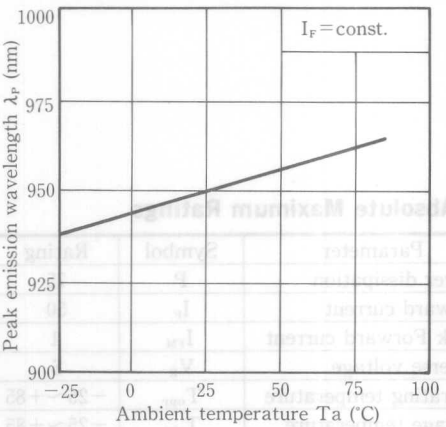


Fig. 5 Forward Current vs. Forward Voltage

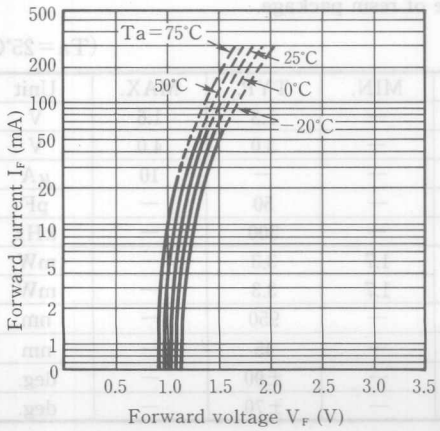


Fig. 6 Relative Radiant Flux vs. Ambient Temperature

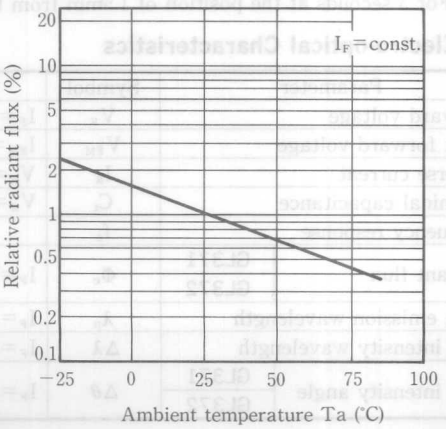


Fig. 7 Radiant Flux vs. Forward Current

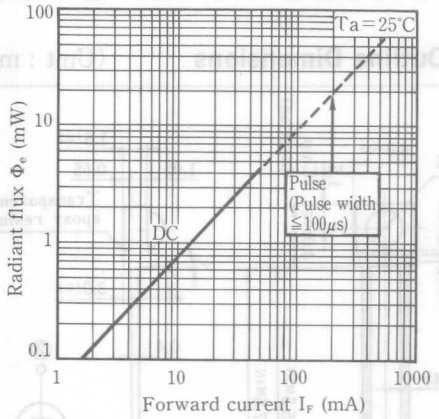


Fig. 8 Relative Radiant Intensity vs. Distance (GL371)

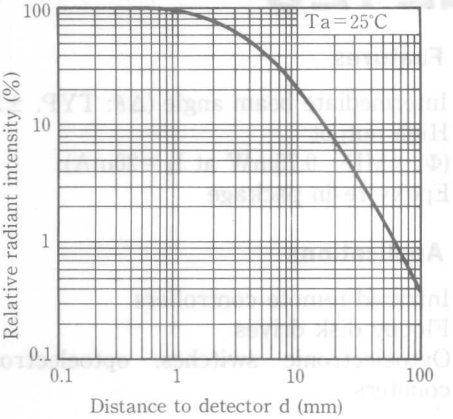


Fig. 9 Relative Radiant Intensity vs. Distance (GL372)

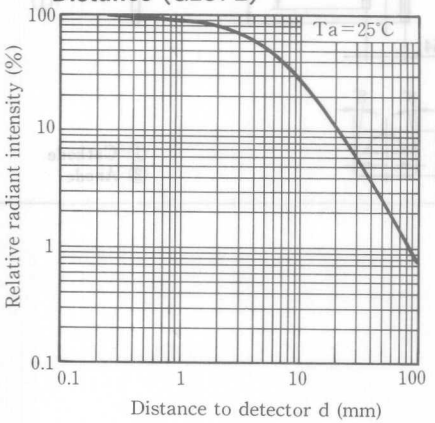


Fig. 10 Radiation Diagram (GL371)

(Ta=25°C)

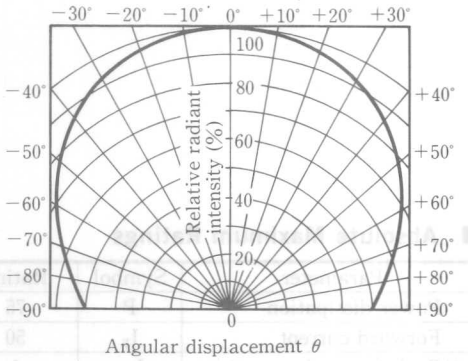
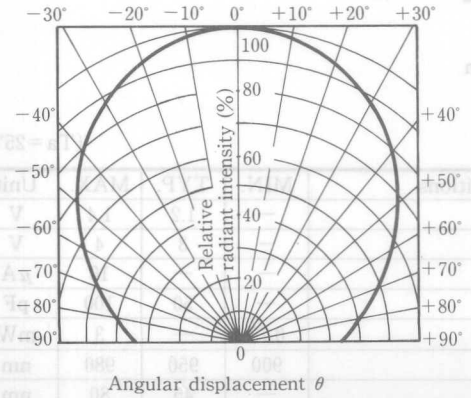


Fig. 11 Radiation Diagram (GL372)

(Ta=25°C)



3

GL420 Resin Mold Type Infrared Light Emitting Diode

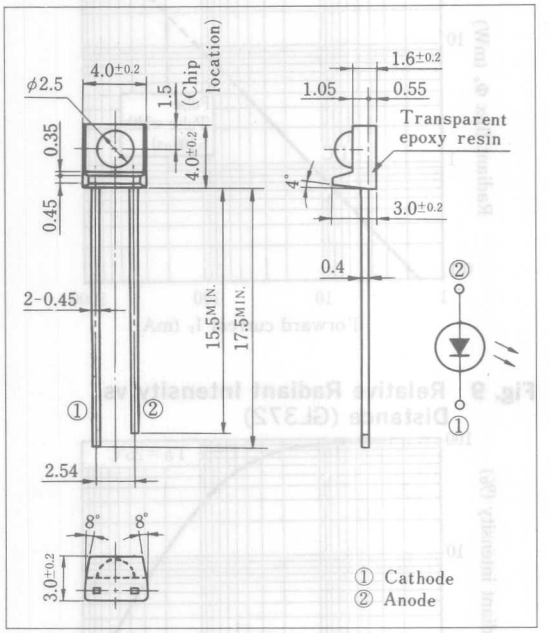
■ Features

1. Intermediate beam angle ($\Delta\theta$: TYP. $\pm 30°$)
2. High output
   (Φ_e : MIN. 0.75mW at I_F=20mA)
3. Epoxy resin package

■ Applications

1. Infrared remote controllers
2. Floppy disk drives
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	75	mW
Forward current	I_F	50	mA
*1 Peak forward current	I_{FM}	1	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*2 Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs
Duty ratio=0.01

*2 For 3 seconds at the position of 2.5mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
Reverse current	I_R	V_R=3V	—	—	10	μA
Terminal capacitance	C_t	V=0, f=1MHz	—	50	100	pF
Radiant flux	Φ_e	I_F=20mA	0.75	—	3	mW
Peak emission wavelength	λ_p	I_F=5mA	900	950	980	nm
Half intensity wavelength	$\Delta\lambda$	I_F=5mA	—	45	80	nm

Fig. 1 Forward Current vs. Ambient Temperature

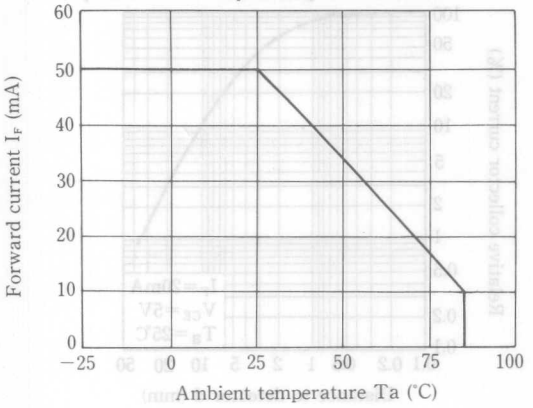
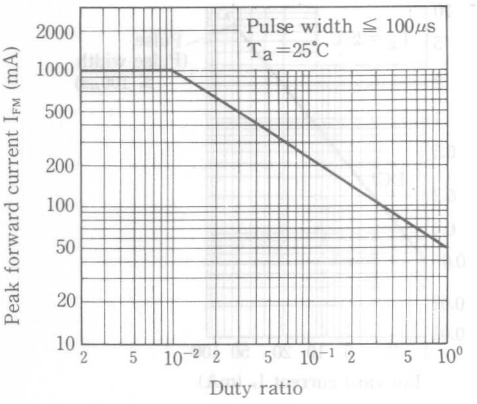


Fig. 2 Peak Forward Current vs. Duty Ratio



3

Fig. 3 Spectral Distribution

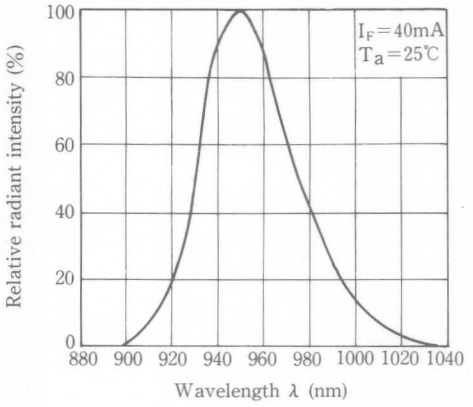


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

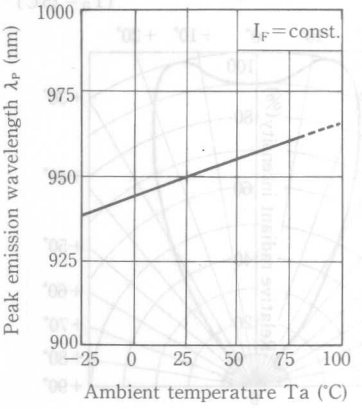


Fig. 5 Forward Current vs. Forward Voltage

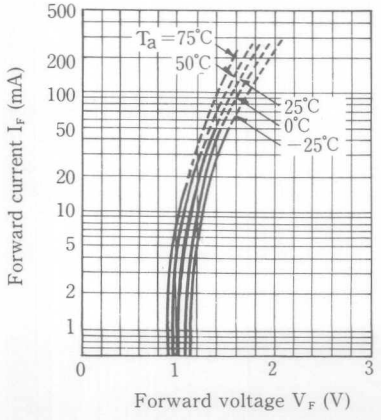


Fig. 6 Relative Radiant Flux vs. Ambient Temperature

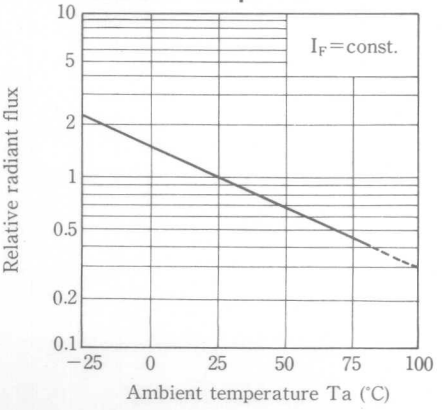


Fig. 7 Radiant Flux vs. Forward Current

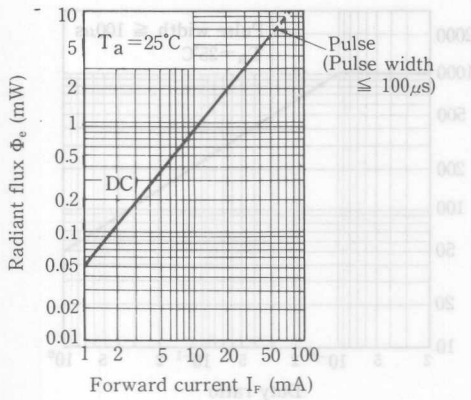


Fig. 8 Relative Collector Current vs. Distance (Detector : PT420F)

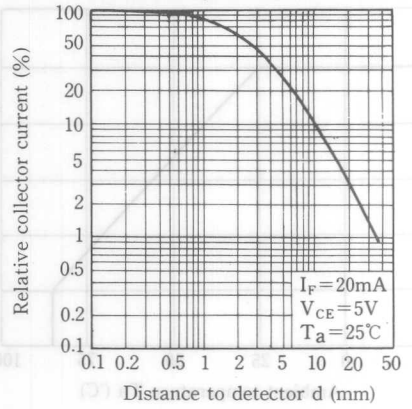
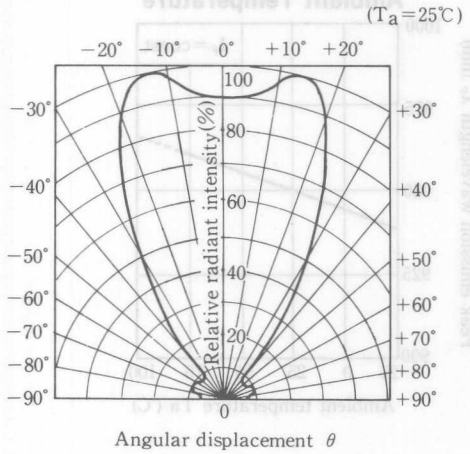


Fig. 9 Radiation Diagram



GL430 Narrow Beam Infrared Light Emitting Diode

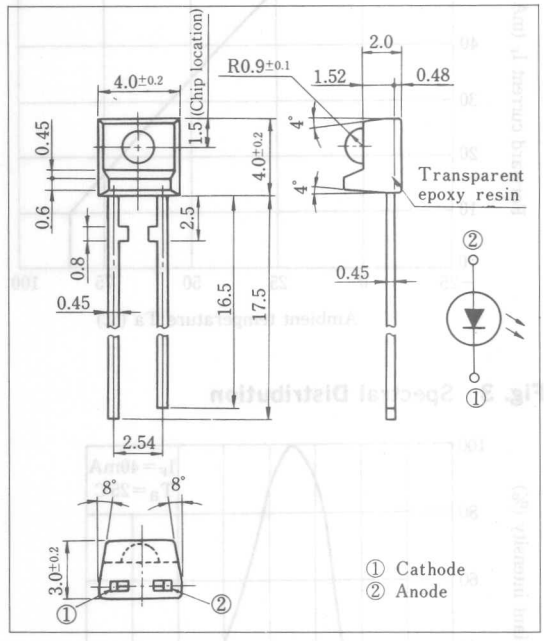
■ Features

1. Narrow beam angle ($\Delta\theta$: TYP. ±13°)
2. Epoxy resin package

■ Applications

1. Optoelectronic switches, optoelectronic counters
2. Smoke detectors, infrared remote controllers

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	75	mW
*1Forward current	I_F	50	mA
Peak forward current	I_{FM}	1	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds at the position of 2.5mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
Reverse current	I_R	V_R=3V	—	—	10	μA
Terminal capacitance	C_t	V=0, f=1MHz	—	50	—	pF
Radiant flux	Φ_e	I_F=20mA	0.5	—	2.0	mW
Peak emission wavelength	λ_p	I_F=5mA	—	950	—	nm
Half intensity wavelength	$\Delta\lambda$	I_F=5mA	—	45	—	nm

3

Fig. 1 Forward Current vs. Ambient Temperature

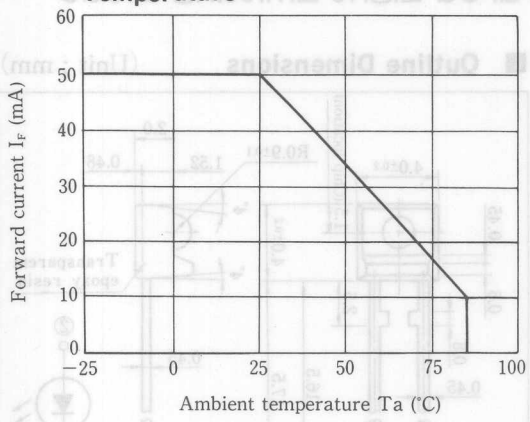


Fig. 2 Peak Forward Current vs. Duty Ratio

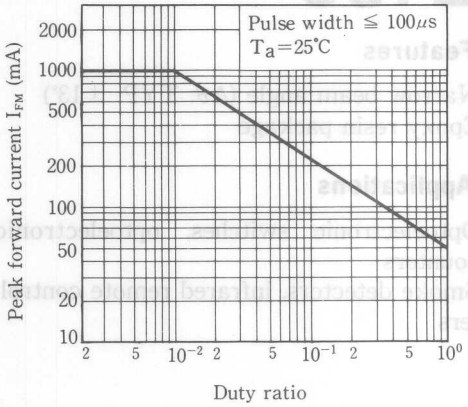


Fig. 3 Spectral Distribution

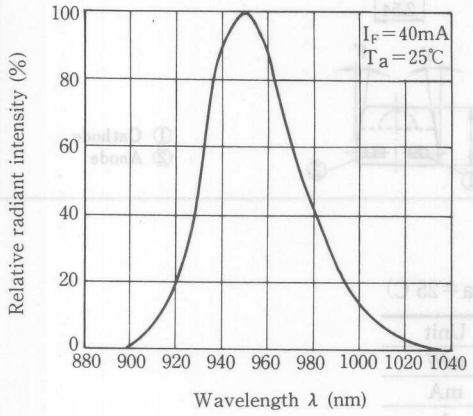


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

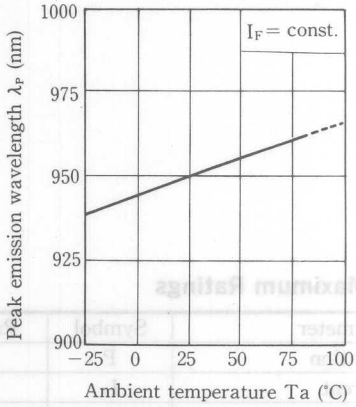


Fig. 5 Forward Current vs. Forward Voltage

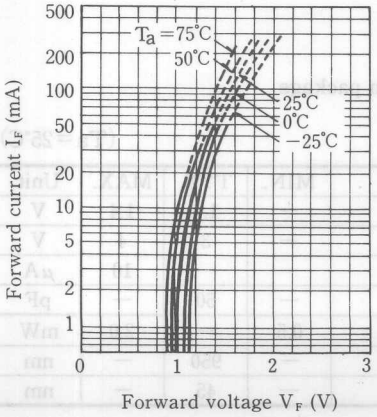


Fig. 6 Relative Radiant Flux vs. Ambient Temperature

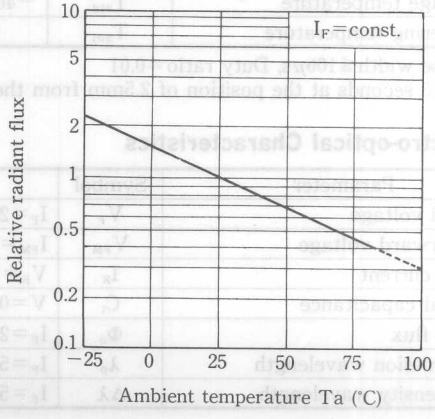


Fig. 7 Radiant Flux vs. Forward Current

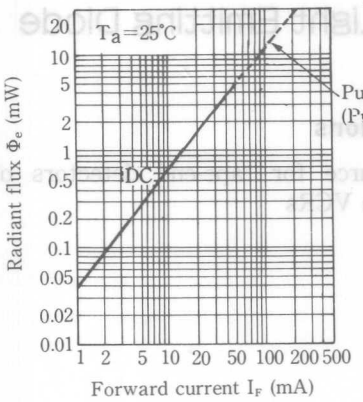


Fig. 8 Relative Radiant Intensity vs. Distance

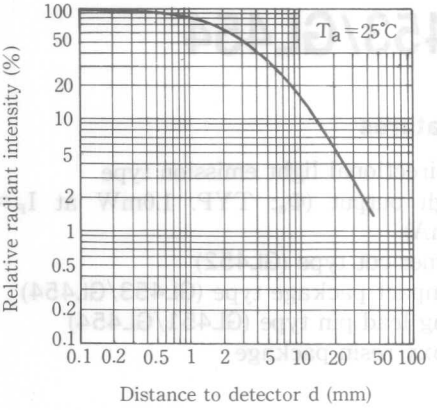


Fig. 9 Relative Collector Current vs. Distance (Detector: PT430)

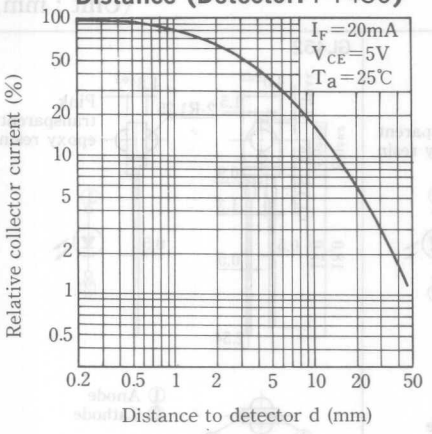
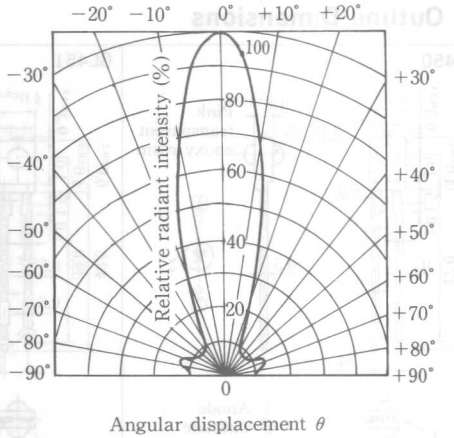


Fig. 10 Radiation Diagram (Ta=25°C)



3

GL450/GL451/GL452 GL453/GL454

Bidirectional Emission Type Infrared Light Emitting Diode

■ Features

1. Bidirectional light emission type
2. High output (Φ_e: TYP. 1.0mW at I_F= 20mA)
3. Corner-cut type (GL452)
   Compact package type (GL453/GL454)
4. Long lead pin type (GL451/GL454)
5. Epoxy resin package

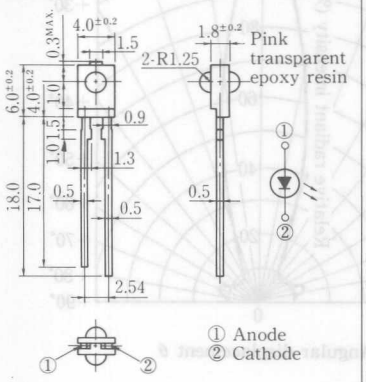
■ Applications

1. Light source for tape-end detectors of VHS type VCRs

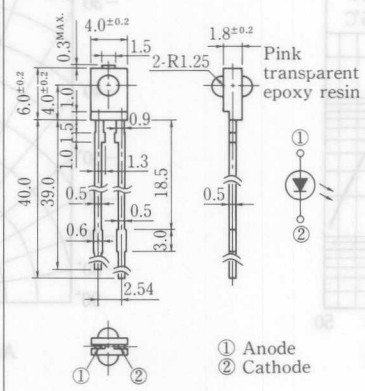
■ Outline Dimensions

(Unit : mm)

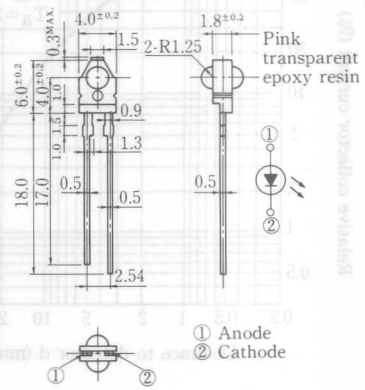
GL450



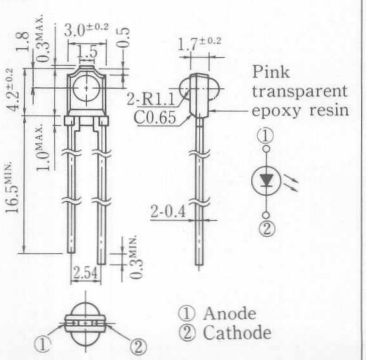
GL451



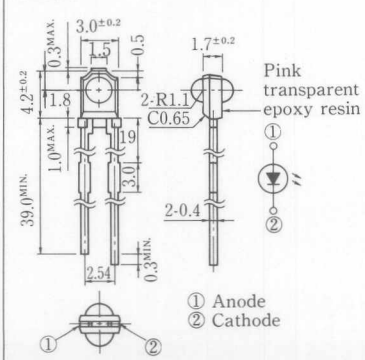
GL452



GL453



GL454



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	75	mW
Forward current	I_F	50	mA
*1Peak forward current	I_{FM}	1	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds at the position of 2.5mm from the bottom face of resin package (GL450/GL451/GL452)
For 3 seconds at the position of 1.8mm from the bottom face of resin package (GL453/GL454)

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	GL450/GL451/GL452	V_F	I_F=20mA	—	1.2	1.4	V
	GL453/GL454			—	1.2	1.5	V
Peak forward voltage		V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
Reverse current		I_R	V_R=3V	—	—	10	μA
Terminal capacitance	GL450/GL451/GL452	C_t	V=0, f=1MHz	—	50	—	pF
	GL453/GL454			—	30	—	pF
Radiant flux	GL450/GL451/GL452	Φ_e	I_F=20mA	0.7	1.0	2.0	mW
	GL453/GL454			0.7	1.0	1.6	mW
Peak emission wavelength		λ_p	I_F=5mA	—	950	—	nm
Half intensity wavelength		$\Delta\lambda$	I_F=5mA	—	45	—	nm

Fig. 1 Forward Current vs. Ambient Temperature

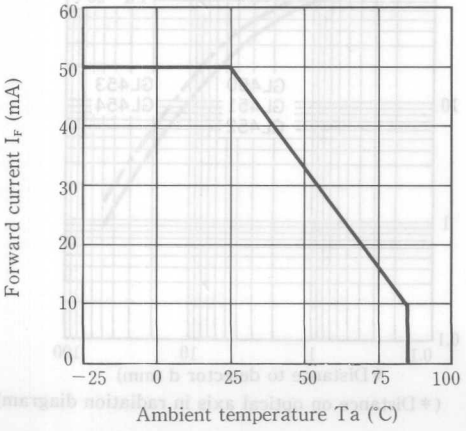


Fig. 2 Peak Forward Current vs. Duty Ratio

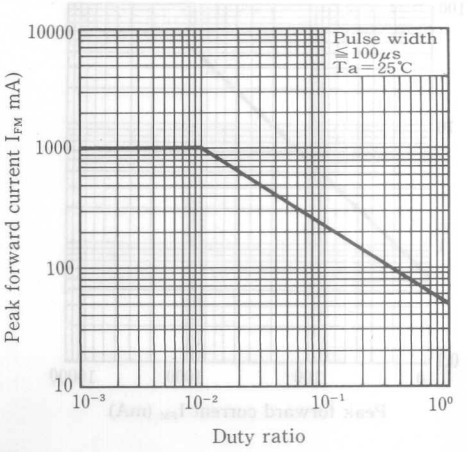


Fig. 3 Spectral Distribution

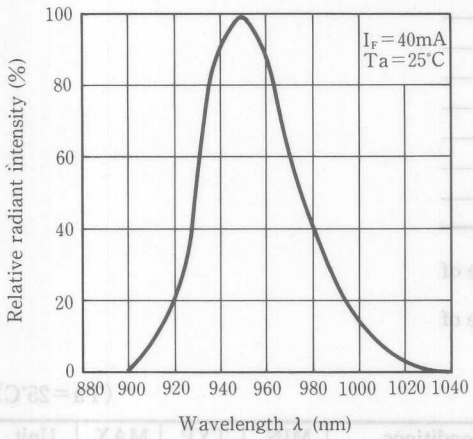


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

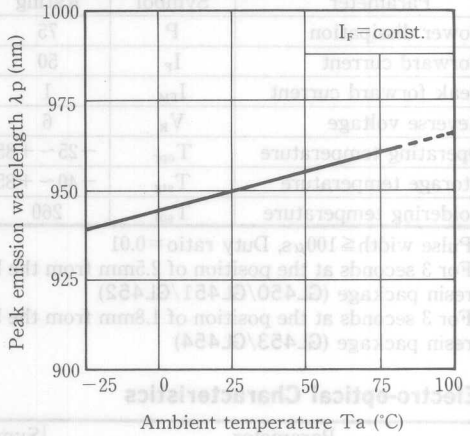


Fig. 5 Forward Current vs. Forward Voltage

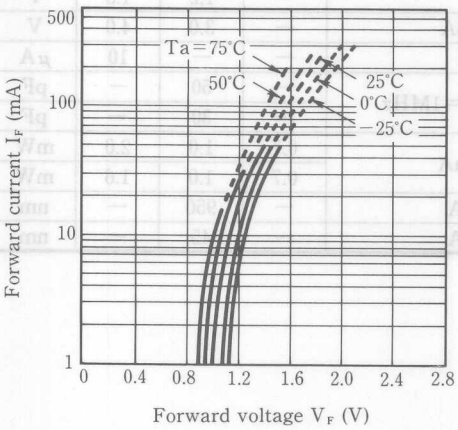


Fig. 6 Relative Radiant Flux vs. Ambient Temperature

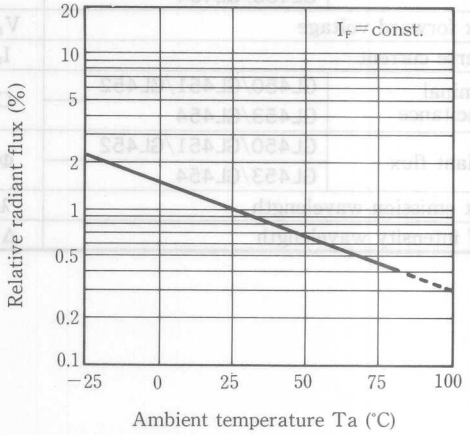


Fig. 7 Relative Radiant Flux vs. Peak Forward Current

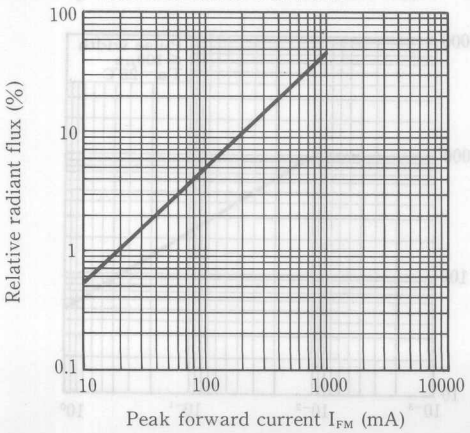
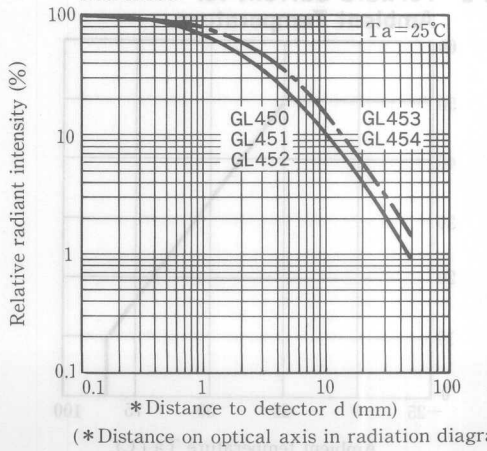


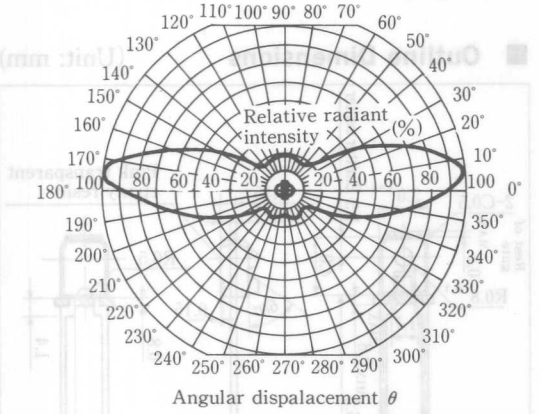
Fig. 8 Relative Radiant Intensity vs. Distance

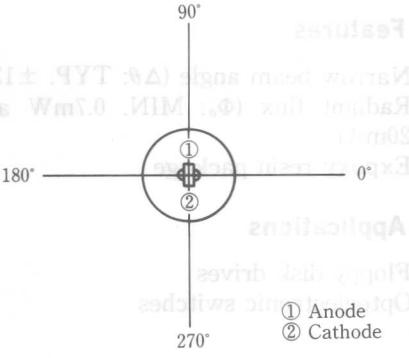


(*Distance on optical axis in radiation diagram)

Fig. 9 Radiation Diagram

(Ta=25°C)





3

GL480 Infrared Light Emitting Diode

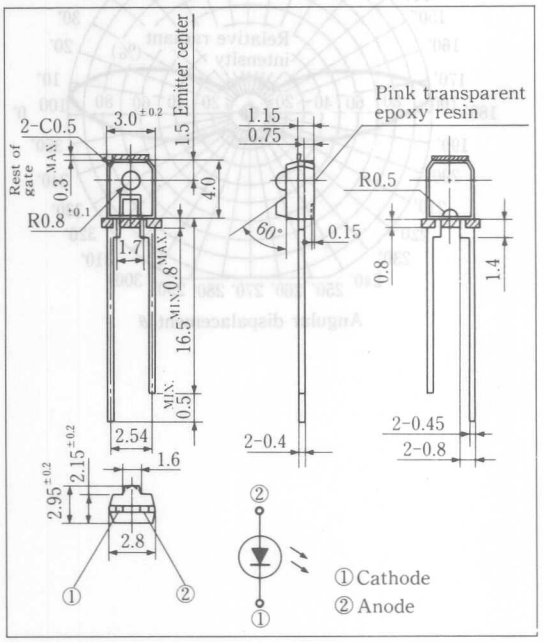
■ Features

1. Narrow beam angle ($\Delta\theta$: TYP. $\pm 13°$)
2. Radiant flux (Φ_e: MIN. 0.7mW at I_F= 20mA)
3. Expoxy resin package

■ Applications

1. Floppy disk drives
2. Optoelectronic switches

■ Outline Dimensions (Unit: mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	75	mW
*1Forward current	I_F	50	mA
Peak forward current	I_{FM}	1	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds at the position of 1.4mm from the bottom face of resin package.

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
Reverse current	I_R	V_R=3V	—	—	10	μA
Terminal capacitance	C_t	V=0, f=1MHz	—	50	—	pF
Radiant flux	Φ_e	I_F=20mA	0.7	—	3.0	mW
Peak emission wavelength	λ_P	I_F=5mA	—	950	—	nm
Half intensity wavelength	$\Delta\lambda$	I_F=5mA	—	45	—	nm

Fig. 1 Forward Current vs. Ambient Temperature

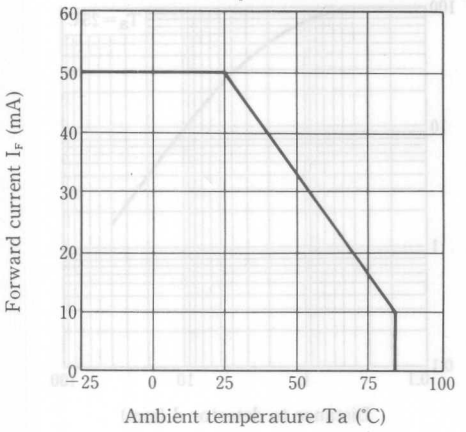


Fig. 2 Peak Forward Current vs. Duty Ratio

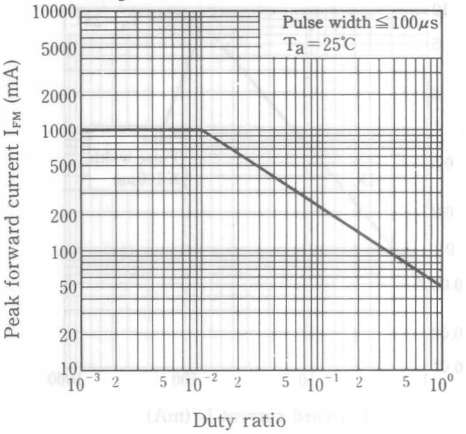


Fig. 3 Spectral Distribution

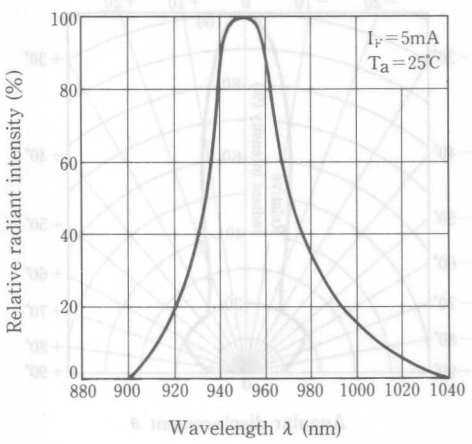


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

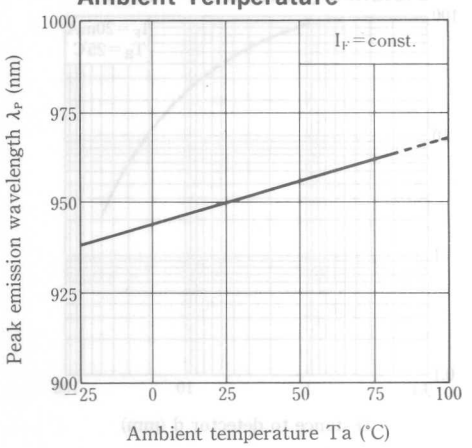


Fig. 5 Forward Current vs. Forward Voltage

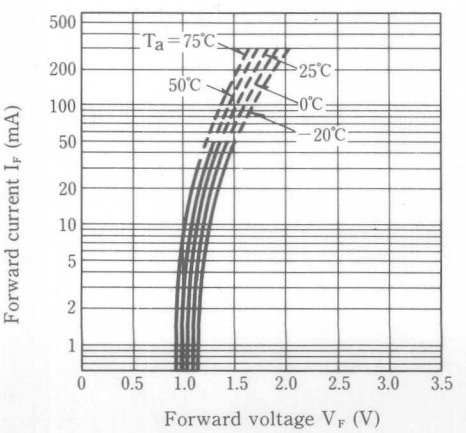
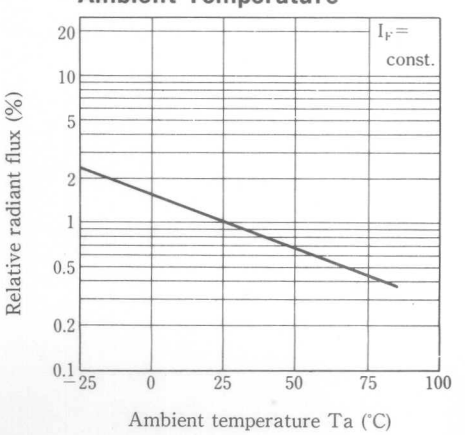


Fig. 6 Relative Radiant Flux vs. Ambient Temperature



3

Fig. 7 Radiant Flux vs. Forward Current

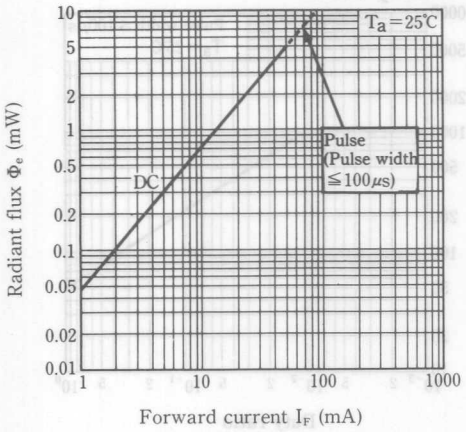


Fig. 8 Relative Radiant Intensity vs. Distance

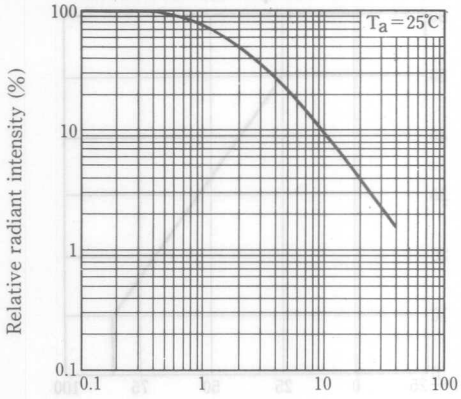


Fig. 9 Relative Collector Current vs. Distance (Detector: PT480)

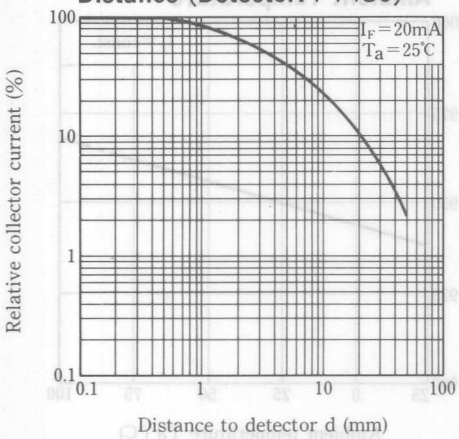
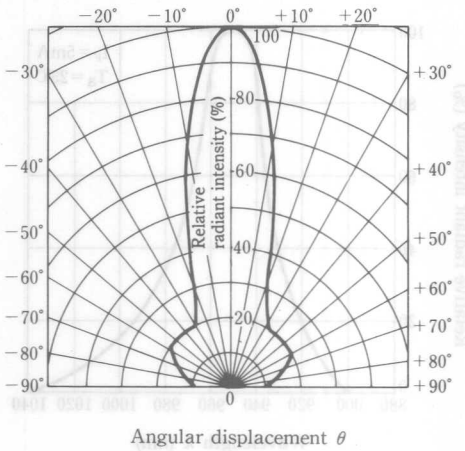


Fig. 10 Radiation Diagram (Ta=25°C)



GL514/GL513F

TO-18 Type Infrared Light Emitting Diode

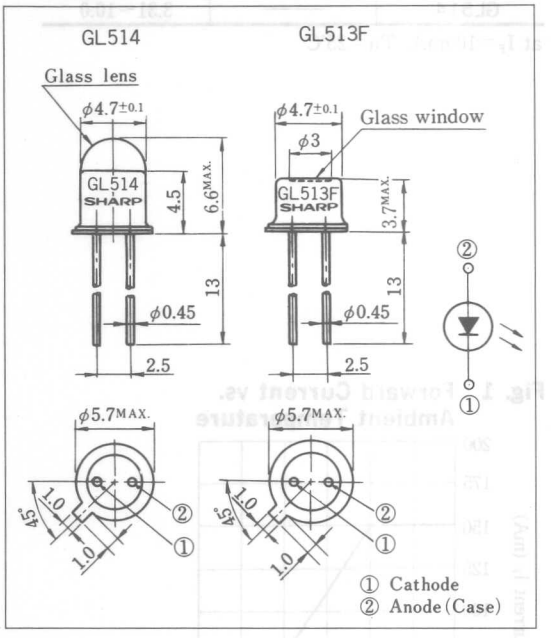
■ Features

1. Output : GL514 Φ_e MIN. 3.31mW at I_F=100mA
   GL513F Φ_e MIN. 1.44mW at I_F=100mA
2. Beam angle : GL514 $\Delta\theta$: TYP. ±7°
   GL513F $\Delta\theta$: TYP. ±50°
3. TO-18 type standard package
4. High reliability, long operation life

■ Applications

1. Optoelectronic switches
2. Smoke detectors
3. Infrared applied systems

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	250	mW
Forward current	I_F	150	mA
*1 Peak forward current	I_{FM}	2	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−40～+125	°C
Storage temperature	T_{stg}	−55～+125	°C
*2 Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦200μs
Duty ratio=0.01
*2 For 10 seconds at the position of 1.3mm from the bottom face of can package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage		V_F	I_F=100mA	—	1.35	1.6	V
Peak forward voltage		V_{FM}	I_{FM}=1.5A	—	2.75	4.0	V
Reverse current		I_R	V_R=5V	—	—	100	μA
Terminal capacitance		C_t	V=0, f=1MHz	—	70	—	pF
*3 Radiant flux	GL514	Φ_e	I_F=100mA	3.31	5.35	10.0	mW
	GL513F			1.44	2.88	—	mW
Peak emission wavelength		λ_p	I_F=100mA	—	950	—	nm
Half intensity wavelength		$\Delta\lambda$	I_F=100mA	—	45	—	nm

3

*3 Classification Table of Radiant Flux (Φ_e)

Model No.	Rank Mark	Φ_e (wW)
GL514A	A	5.35~10.0
GL514	———	3.31~10.0

at I_F=100mA, Ta=25°C

Fig. 1 Forward Current vs. Ambient Temperature

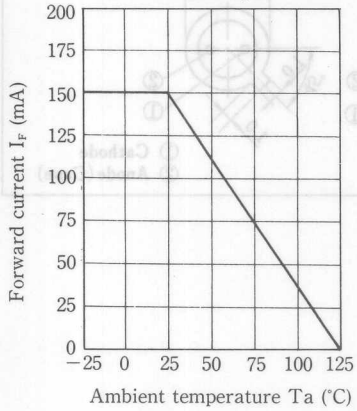


Fig. 2 Peak Forward Current vs. Duty Ratio

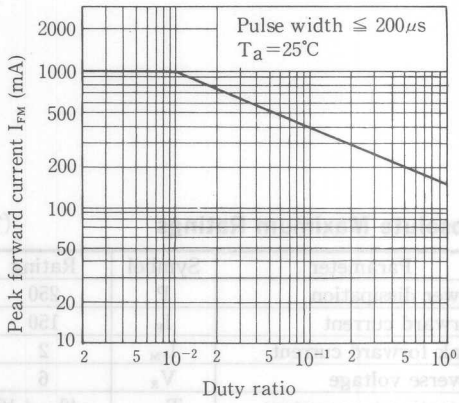


Fig. 3 Spectral Distribution

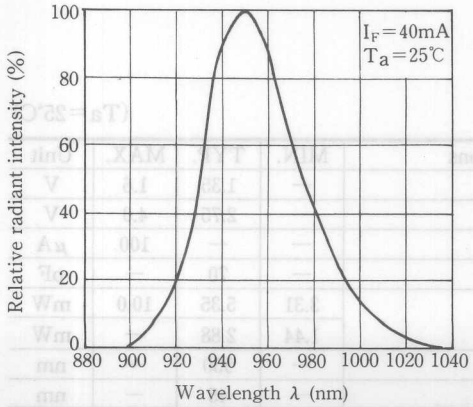


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

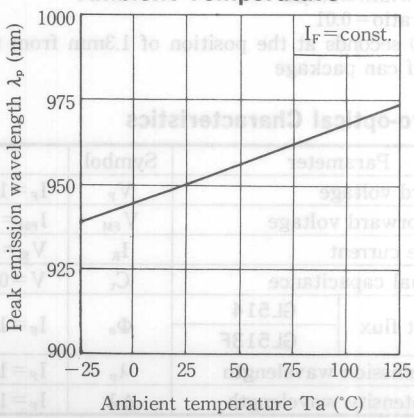


Fig. 5 Forward Current vs. Forward Voltage

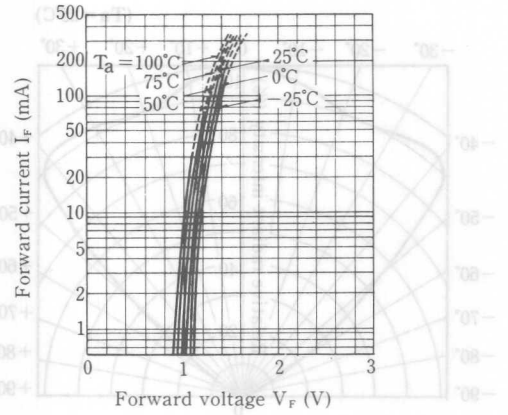


Fig. 6 Relative Radiant Flux vs. Ambient Temperature

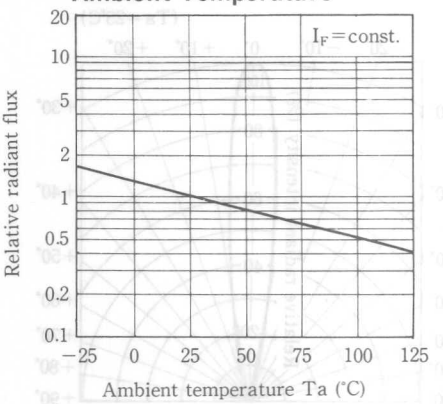


Fig. 7 Radiant Flux vs. Forward Current (GL514)

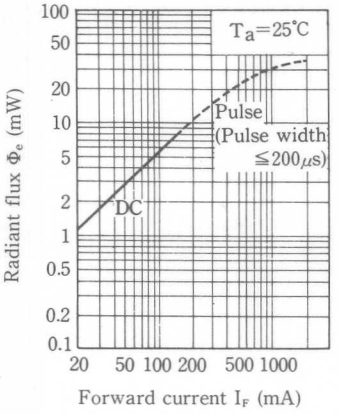


Fig. 8 Radiant Flux vs. Forward Current (GL513F)

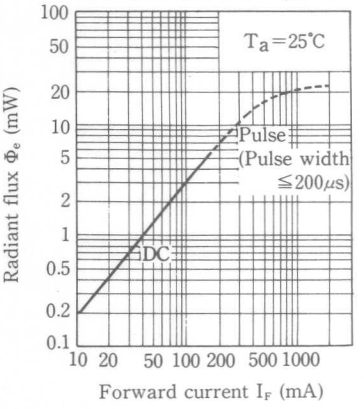


Fig. 9 Relative Radiant Intensity vs. Distance (GL514)

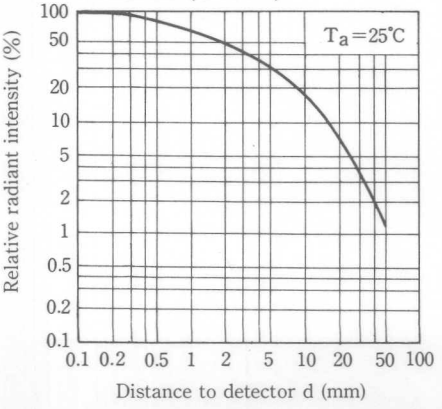
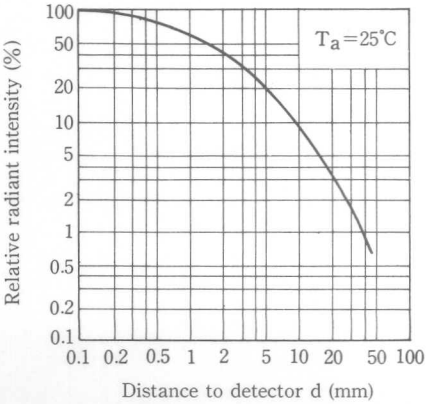


Fig. 10 Relative Radiant Intensity vs. Distance (GL513F)



3

Fig. 11 Radiation Diagram (GL514)

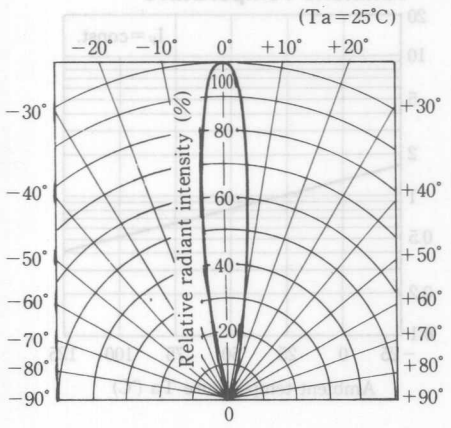
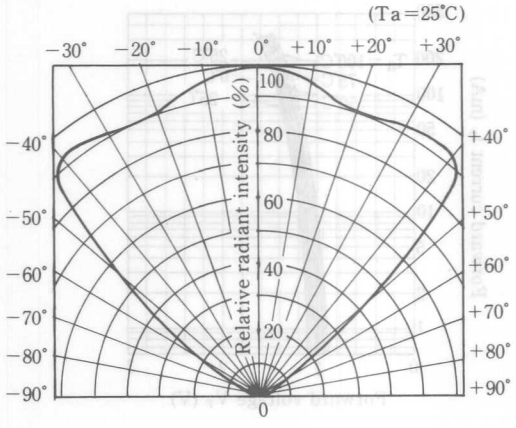


Fig. 12 Radiation Diagram (GL513F)



GL518 TO-18 Type Infrared Light Emitting Diode

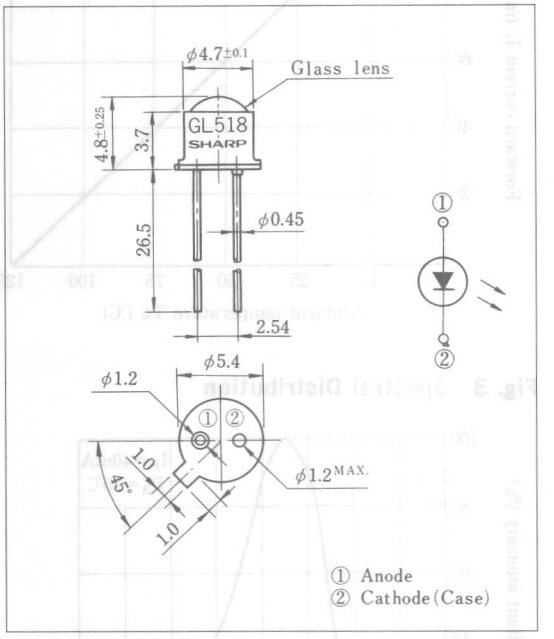
■ Features

1. Narrow beam angle ($\Delta\theta$: TYP. $\pm 10°$)
2. High output
   (Φ_e: MIN. 2.0mW at I_F=50mA)
3. TO-18 type standard package
4. High reliability, long operation life

■ Applications

1. Optical rotary encoders
2. Optoelectronic switches, optoelectronic counters
3. Infrared applied systems

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	120	mW
Forward current	I_F	80	mA
*1Peak forward current	I_{FM}	1	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−25～+125	°C
Storage temperature	T_{stg}	−55～+125	°C
*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 10 seconds at the position of 1.3mm from the bottom face of can package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_F	I_F=50mA	—	1.3	1.6	V
Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	2.1	4.0	V
Reverse current	I_R	V_R=3V	—	—	10	μA
Terminal capacitance	C_t	V=0, f=1MHz	—	50	—	pF
Radiant flux	Φ_e	I_F=50mA	2.0	3.0	—	mW
Peak emission wavelength	λ_p	I_F=5mA	—	950	—	nm
Half intensity wavelength	$\Delta\lambda$	I_F=5mA	—	45	—	nm

Fig. 1 Forward Current vs. Ambient Temperature

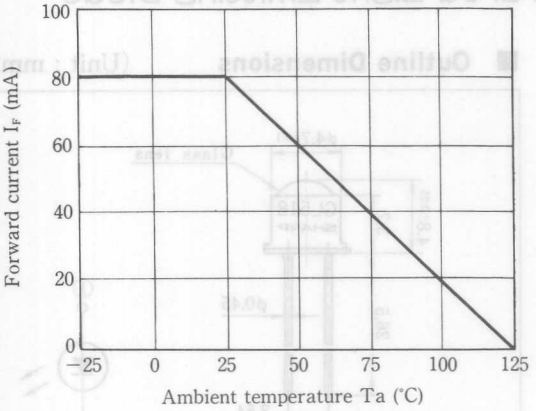


Fig. 2 Peak Forward Current vs. Duty Ratio

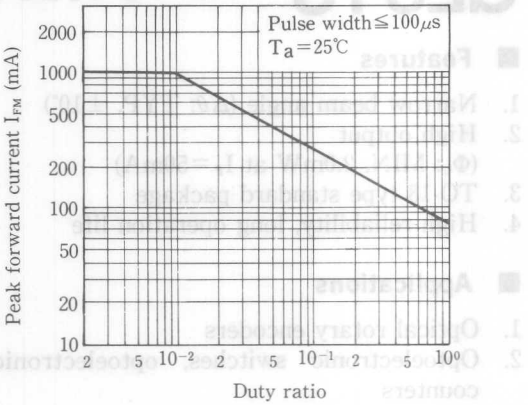


Fig. 3 Spectral Distribution

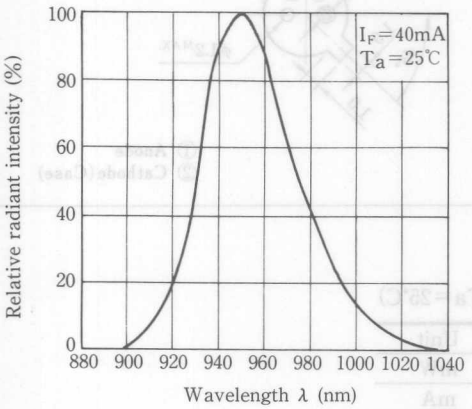


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

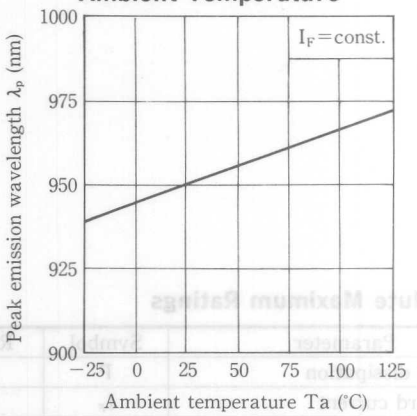


Fig. 5 Forward Current vs. Forward Voltage

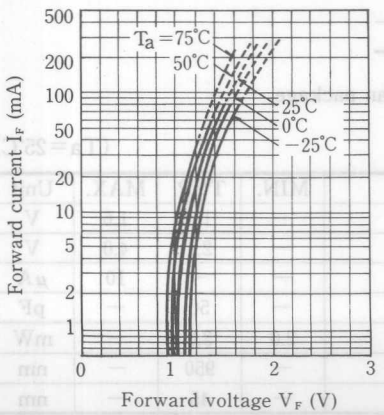


Fig. 6 Relative Forward Voltage vs. Ambient Temperature

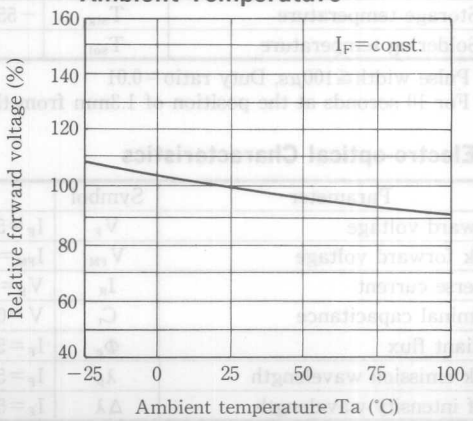


Fig. 7 Radiant Flux vs. Peak Forward Current

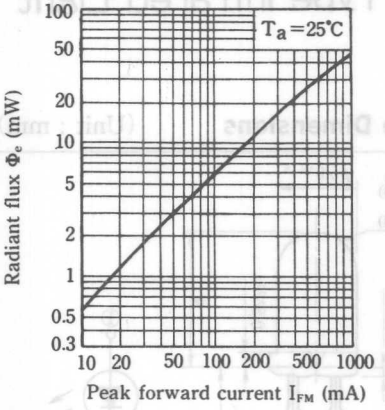


Fig. 8 Relative Radiant Intensity vs. Distance

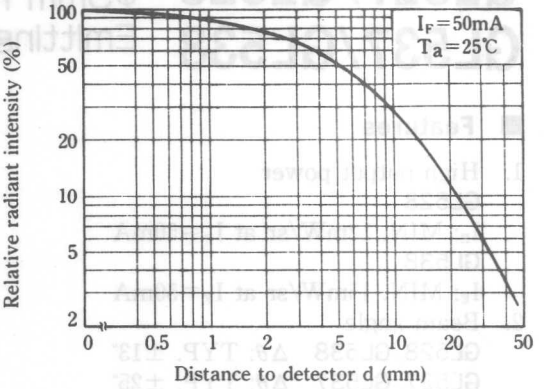
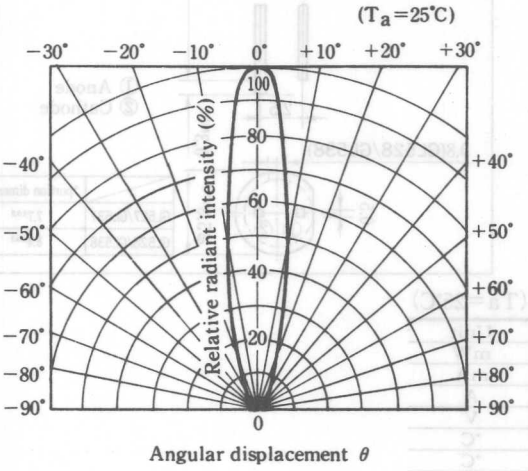


Fig. 9 Radiation Diagram



GL527/GL528 GL537/GL538

ϕ5mm Resin Mold Type Infrared Light Emitting Diode

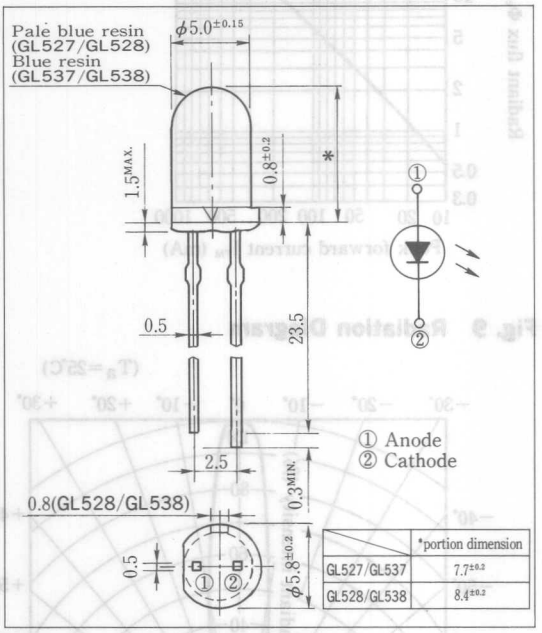
■ Features

1. High output power
   GL528
   I_E: MIN. 12mW/sr at I_F=50mA
   GL538
   I_E: MIN. 15mW/sr at I_F=50mA
2. Beam angle
   GL528/GL538 $\Delta\theta$: TYP. ±13°
   GL527/GL537 $\Delta\theta$: TYP. ±25°
3. ϕ5mm epoxy resin package

■ Applications

1. Infrared remote controllers for TVs, VCRs, audio equipment and air conditioners

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	150	mW
Forward current	I_F	100	mA
*1Peak forwad current	I_{FM}	1	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds at the position of 2.6mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage		V_F	I_F=50mA	—	1.3	1.5	V
Peak forward voltage		V_{FM}	I_{FM}=0.5A	—	1.9	3.0	V
Reverse current		I_R	V_R=3V	—	—	10	μA
Terminal capacitance		C_t	V_R=0, f=1kHz	—	50	140	pF
Response frequency		f_c		—	300	—	kHz
*3Radiation intensity	GL527	I_E	I_F=50mA	5.0	10	—	mW/sr
	GL528			12	23	—	
	GL537			6.0	13	—	
	GL538			15	30	—	
Peak emission wavelength	GL527/GL528	λ_p	I_F=5mA	—	940	—	nm
	GL537/GL538			—	950	—	
Half intensity wavelength		$\Delta\lambda$	I_F=5mA	—	45	—	nm
Half intensity angle	GL527/GL537	$\Delta\theta$		—	±25	—	deg.
	GL528/GL538			—	±13	—	deg.

*3 I_E: Value obtained by converting the value in power of radiant fluxes emitted at the solid angle of 0.01 sr (steradian) in the direction of mechanical axis of the lens portion into 1 sr of all those emitted from the light emitting diode.

Fig. 1 Forward Current vs. Ambient Temperature

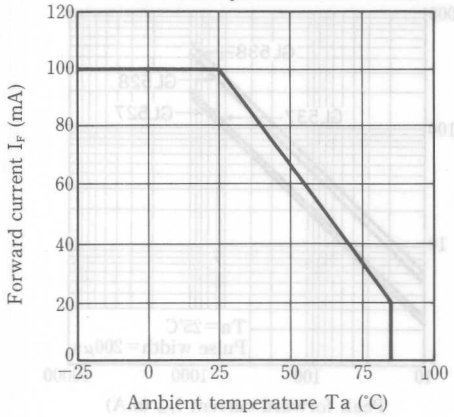


Fig. 2 Peak Forward Current vs. Duty Ratio

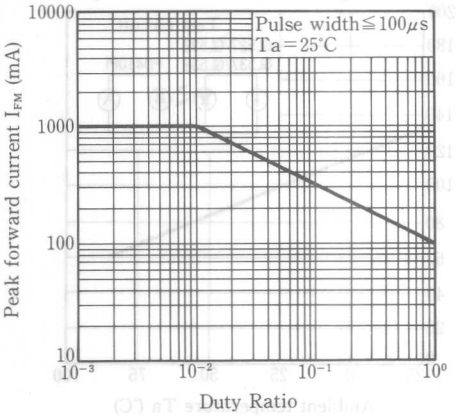


Fig. 3 Spectral Distribution (GL527/GL528)

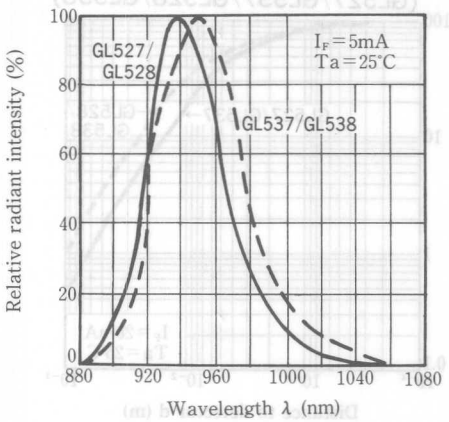


Fig. 4 Peak Emission Wave length vs. Ambient Temperature

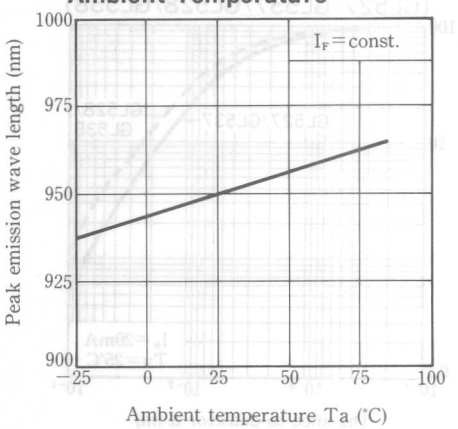


Fig. 5 Forward Current vs. Forward Voltage

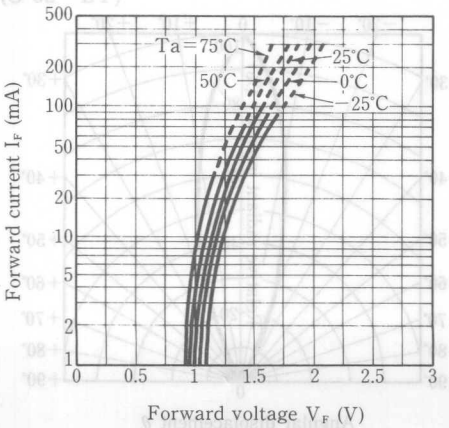
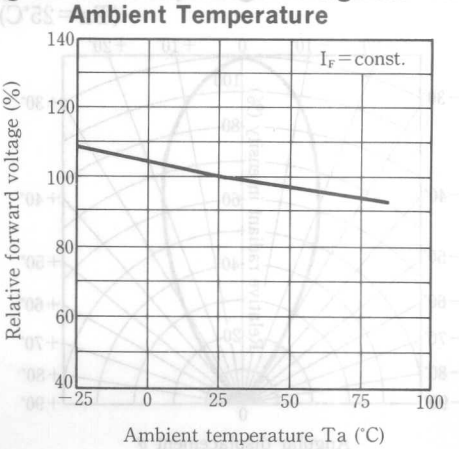


Fig. 6 Relative Forward Voltage vs. Ambient Temperature



3

Fig. 7 Relative Output vs. Ambient Temperature (Detector : PD410PI)

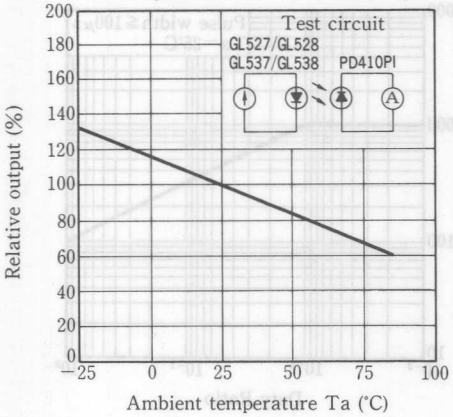


Fig. 8 Radiation Intensity vs. Peak Forward Current

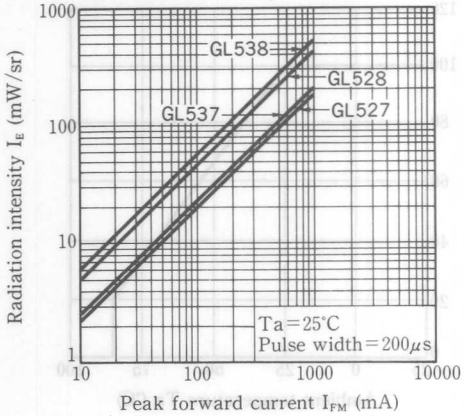


Fig. 9 Relative Collector Current vs. Distance(Detector : PD410PI) (GL527/GL537/GL528/GL538)

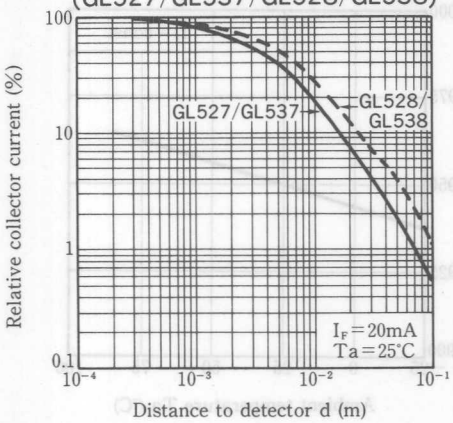


Fig. 10 Relative Collector Current vs. Distance (Detector : PD49PI) (GL527/GL537/GL528/GL538)

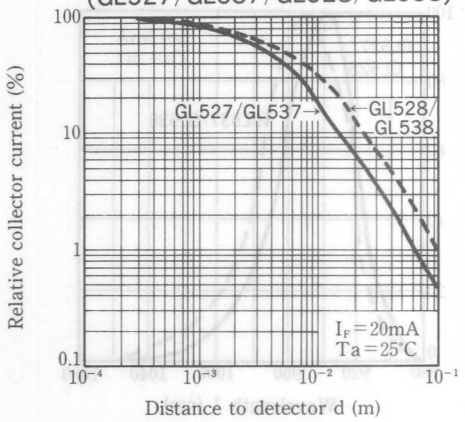


Fig. 11 Radiation Diagram (GL527/GL537) (Ta=25°C)

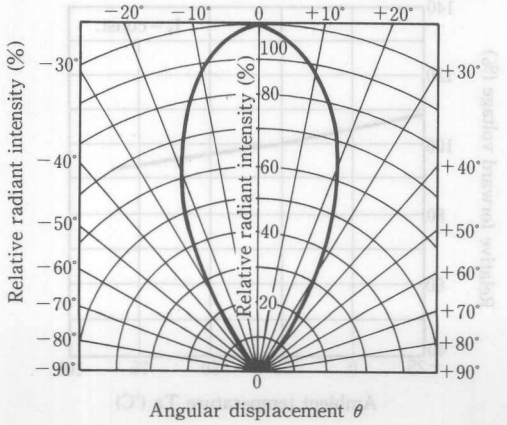
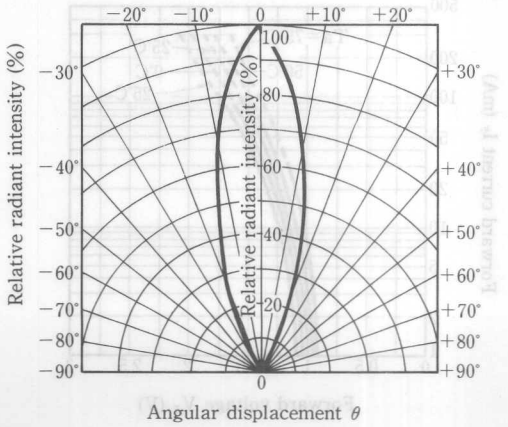


Fig. 12 Radiation Diagram (GL528/GL538) (Ta=25°C)



GL4800 Thin Type Infrared Light Emitting Diode

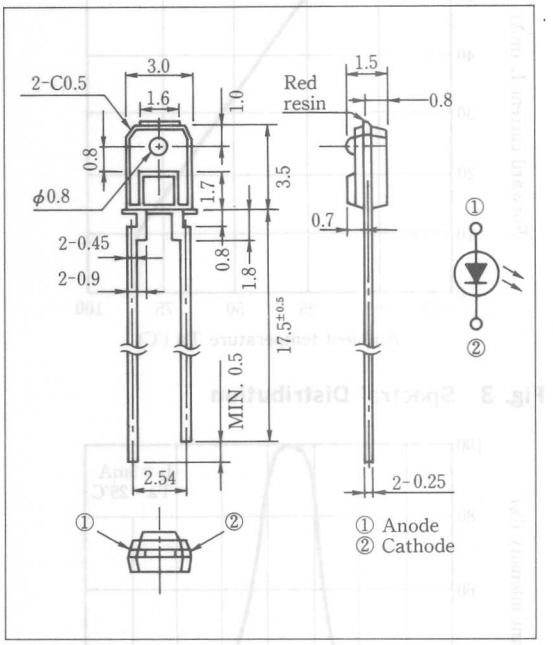
■ Features

1. Thin type (Thickness: 1.5mm)
2. Beam angle ($\Delta\theta$: TYP. $\pm 30°$)
3. Radiant flux
   (Φ_e: MIN. 0.7mW at $I_F = 20mA$)
4. Epoxy resin package

■ Applications

1. Floppy disk drives
2. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power dissipation	P	75	mW
Forward current	I_F	50	mA
*1Peak forward current	I_{FM}	1	A
Reverse voltage	V_R	6	V
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width=100μs, Duty ratio=0.01
*2 For 3 seconds at the position of 1.8mm from the surface of resin edge.

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
Reverse current	I_R	V_R=3V	—	—	10	μA
Terminal capacitance	C_t	V_R=0, f=1MHz	—	70	—	pF
Frequency response	f_c		—	300	—	kHz
Radiant flux	Φ_e	I_F=20mA	0.7	1.6	3.0	mW
Peak emission wavelength	λp	I_F=5mA	—	950	—	nm
Half intensity wavelength	Δλ	I_F=5mA	—	45	—	nm

3

Fig. 1 Forward Current vs. Ambient Temperature

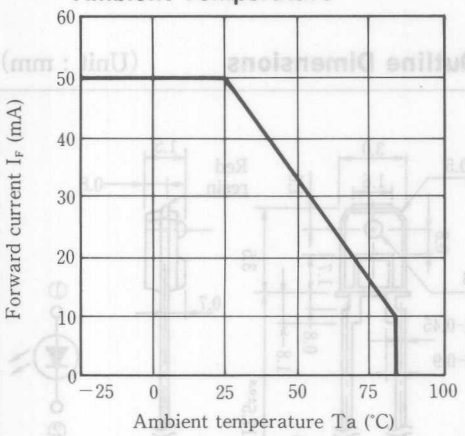


Fig. 2 Peak Forward Current vs. Duty Ratio

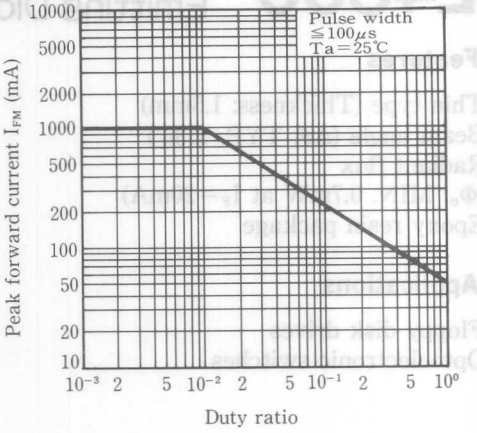


Fig. 3 Spectral Distribution

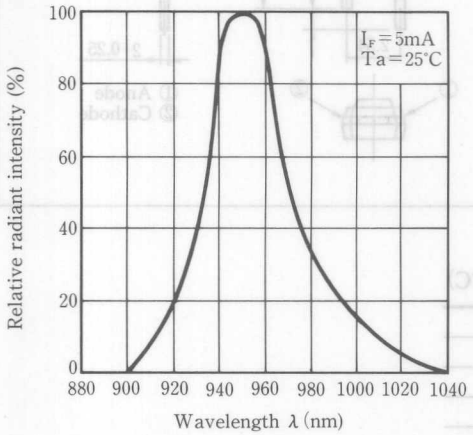


Fig. 4 Peak Emission Wavelength vs. Ambient Temperature

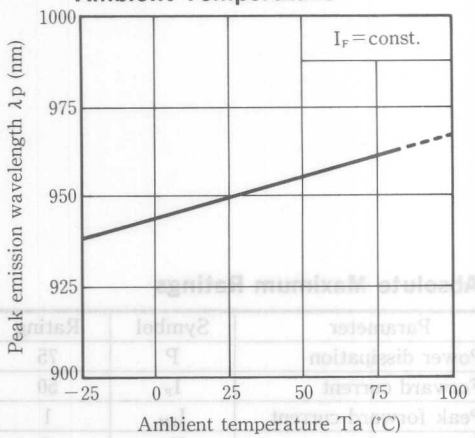


Fig. 5 Forward Current vs. Forward Voltage

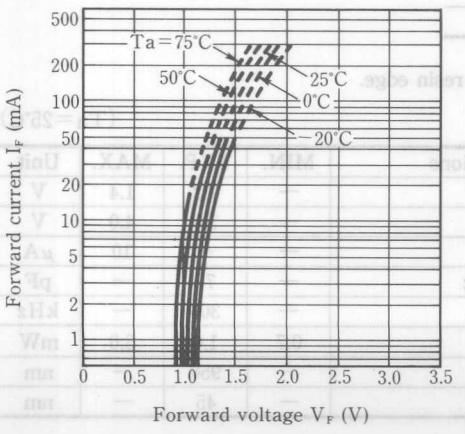


Fig. 6 Relative Radiant Flux vs. Ambient Temperature

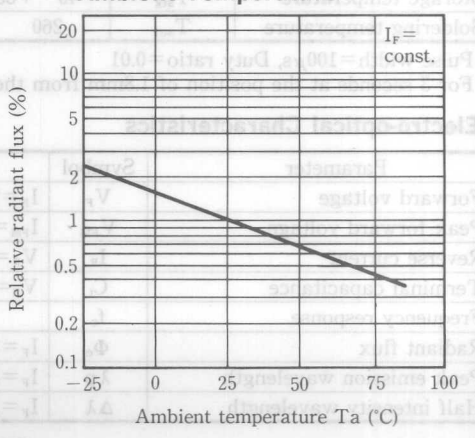


Fig. 7 Radiant Flux vs. Forward Current

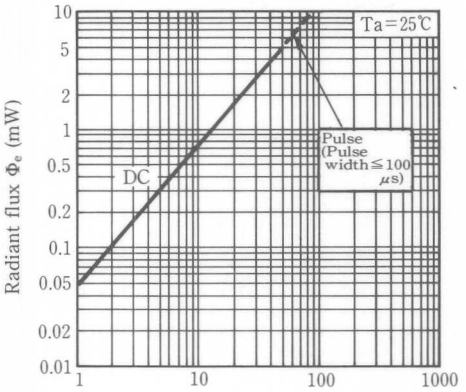


Fig. 8 Relative Radiant Intensity vs. Distance

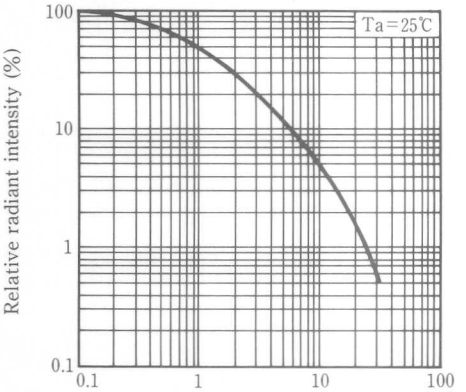


Fig. 9 Relative Collector Current vs. Distance (Detector: PT4800)

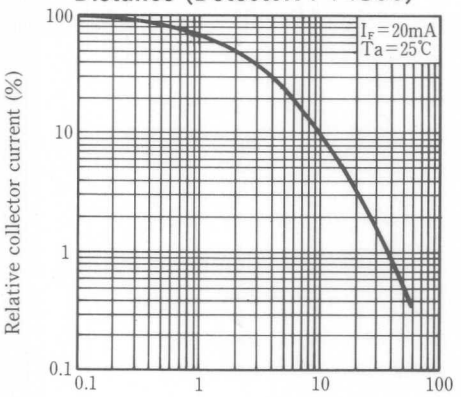
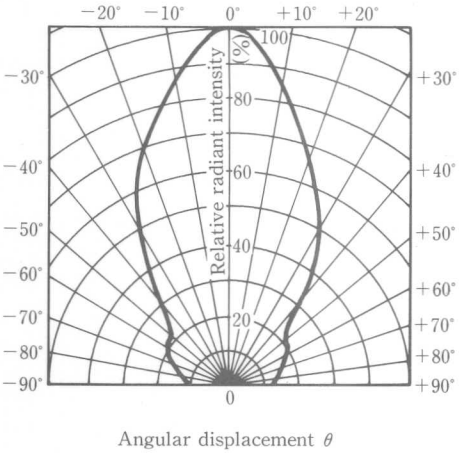


Fig. 10 Radiation Diagram (Ta=25°C)



3

Fig. 7 Radiant Flux vs. Forward Current

Fig. 8 Relative Radiant Intensity vs. Distance

Fig. 9 Relative Collector Current vs. Distance (Detector: PT4800)

Fig. 10 Radiation Diagram (Ta=25°C)

Photodiodes

PD43PI High Speed Photodiode

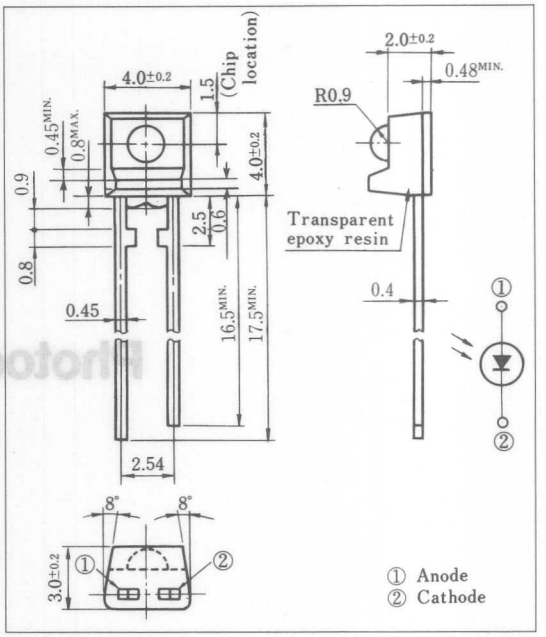
■ Features

1. High speed response
   (t_r, t_f: TYP. 100ns at R_L=1kΩ)
2. Intermediate acceptance ($\Delta\theta$: TYP. ±25°)
3. Transparent epoxy resin package

■ Applications

1. Smoke detectors, optoelectronic switches
2. High speed light signal detection

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	20	V
Power dissipation	P	75	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 3 seconds at the position of 2.5mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Short circuit current	I_{SC}	E_V=100 ℓx	1.0	1.7	2.4	μA
Dark current	I_d	V_R=10V	—	—	10	nA
Terminal capacitance	C_t	V_R=0, f=1MHz	—	5	—	pF
Peak sensitivity wavelength	λ_p		—	920	—	nm
Response time	t_r, t_f	R_L=1kΩ, V_R=10V	—	100	—	ns

*2 E_V: Illuminance by CIE standard light source A (tungsten lamp)

Fig. 1 Power Dissipation vs. Ambient Temperature

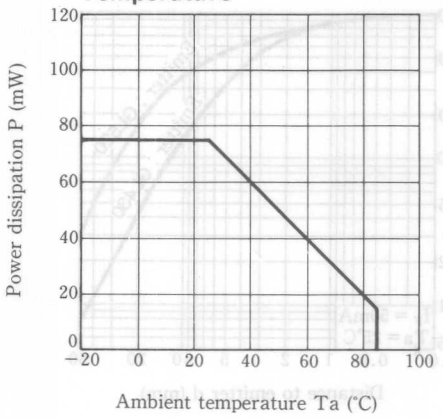


Fig. 2 Spectral Sensitivity

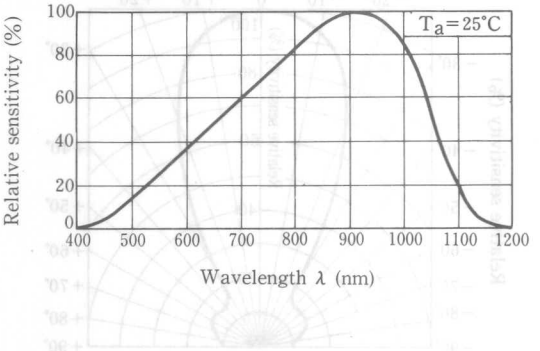


Fig. 3 Dark Current vs. Ambient Temperature

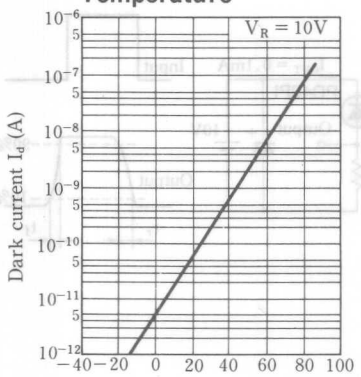


Fig. 4 Dark Current vs. Reverse Voltage

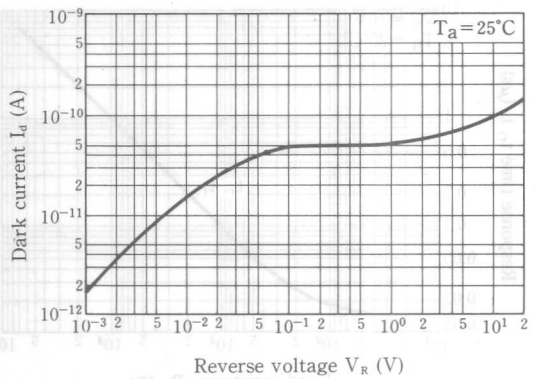


Fig. 5 Terminal Capacitance vs. Reverse Voltage

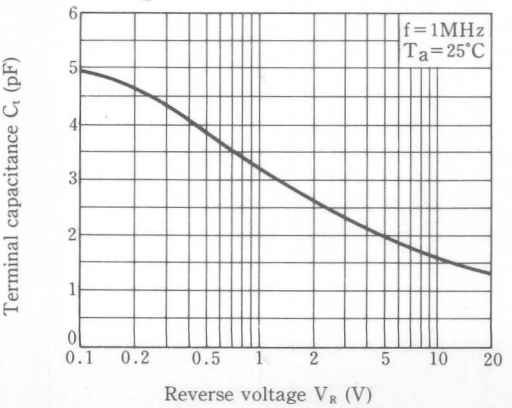
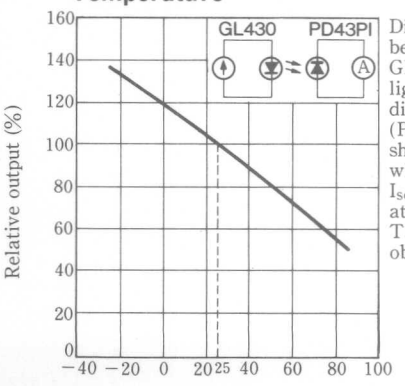


Fig. 6 Relative Output vs. Ambient Temperature



Distance between GL (Infrared light emitting diode) and PD (Photodiode) shall be fixed when $I_{SC}=25\mu A$ at $I_F=20mA$, Ta=25°C is obtained.

4

Fig. 7 Sensitivity Diagram

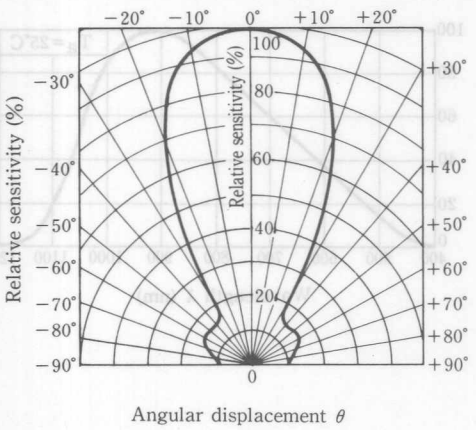


Fig. 8 Relative Output vs. Distance

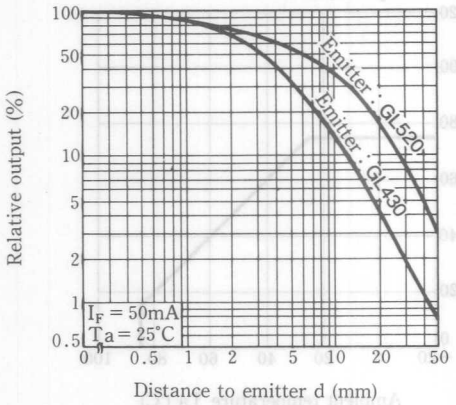
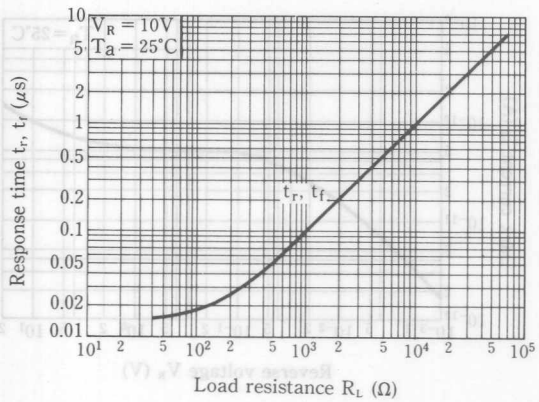
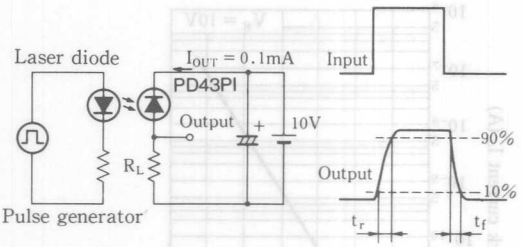


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



PD49PI/PD481PI High Speed, High Sensitivity Photodiode

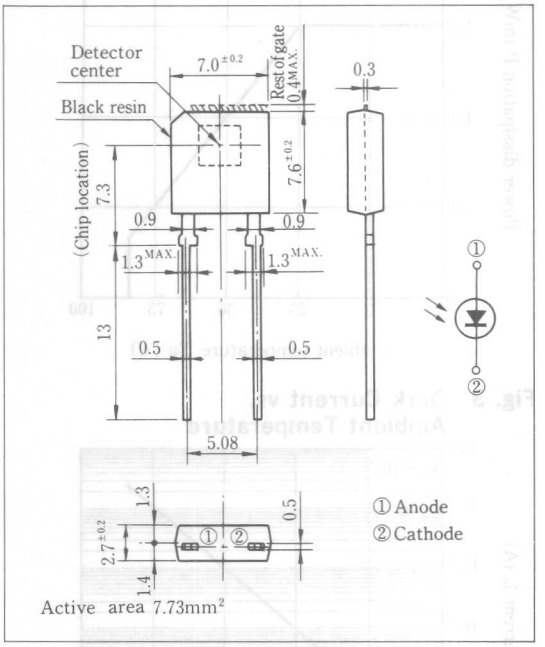
■ Features

1. High sensitivity
   ($I_{SC} \geqq 3.5\mu A$ at $E_V = 100\ \ell x$: PD481PI)
2. Peak sensitivity wavelength matching with infrared LED
   ($\lambda p = 960nm$: PD481PI)
   ($\lambda p = 1000nm$: PD49PI)
3. Built-in visible light cut-off filter

■ Applications

1. Infrared remote controllers for TVs, VCRs, audio equipment and air conditioners, etc.

■ Outline Dimensions (Unit: mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	32	V
Power dissipation	P	150	mW
Operating temperature	T_{opr}	−25 ~ +85	°C
Storage temperature	T_{stg}	−40 ~ +100	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 10 seconds at the position of 2.3mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Short circuit current	PD49PI	I_{SC}	$E_V = 100\ell x$	2.4	3	—	μA
	PD481PI			3.5	5	—	
*2Short circuit current temperature coefficient		β_T	$E_V = 100\ell x$	—	0.2	—	%/°C
Dark current		I_d	$V_R = 10V$	—	1	30	nA
Dark current temperature coefficient		α_T	$V_R = 10V$	—	3.5	5	times/10°C
Terminal capacitance		C_t	$V_R = 3V$, f=1MHz	—	20	50	pF
Peak sensitivity wavelength	PD49PI	λ_p		—	1,000	—	nm
	PD481PI			910	960	1,010	

*2 E_V: Illuminance by CIE standard light source A (tungsten lamp)

4

Fig. 1 Power Dissipation vs. Ambient Temperature

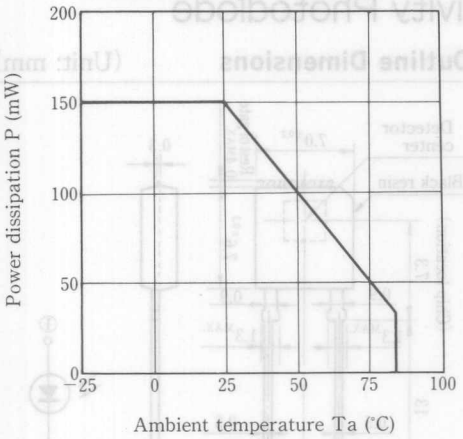


Fig. 2 Spectral Sensitivity

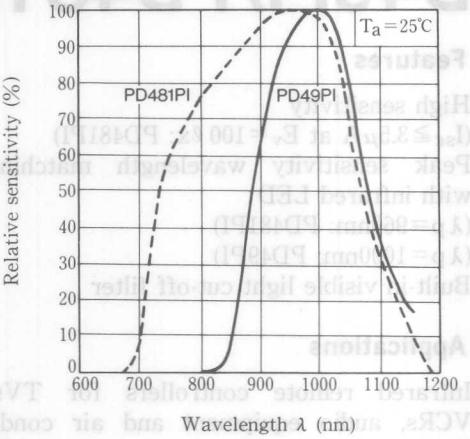


Fig. 3 Dark Current vs. Ambient Temperature

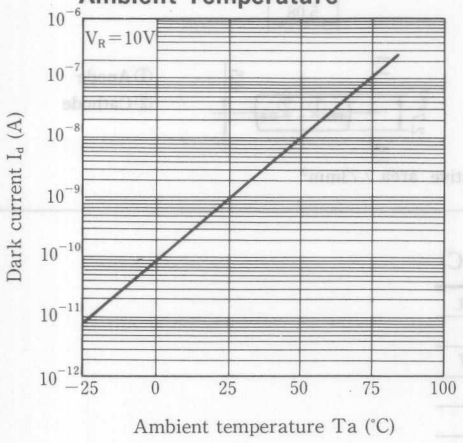


Fig. 4 Dark Current vs. Reverse Voltage

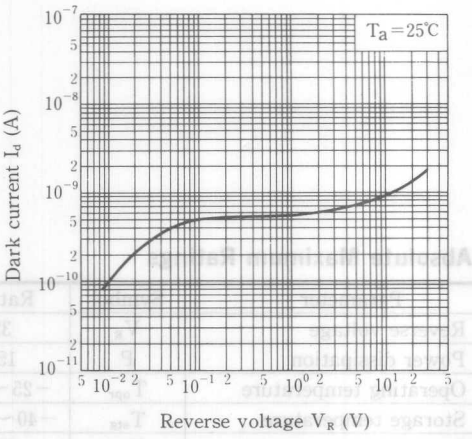


Fig. 5 Terminal Capacitance vs. Reverse Voltage

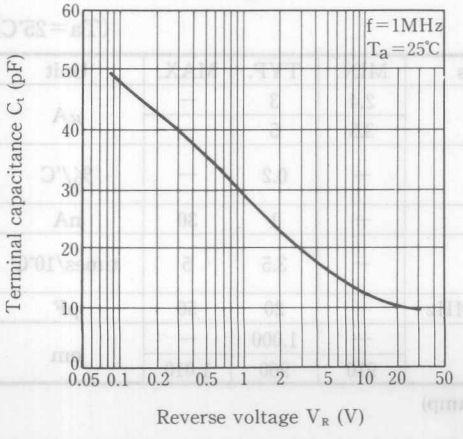


Fig. 6 Relative Output vs. Ambient Temperature (Emitter: GL521)

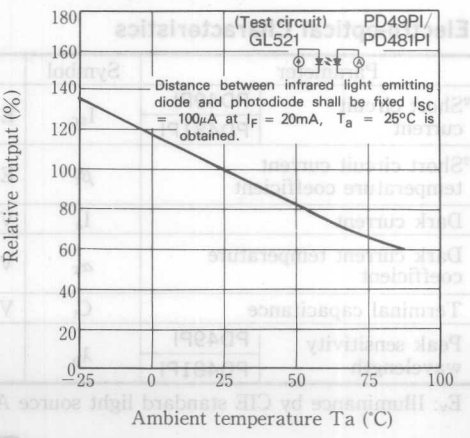
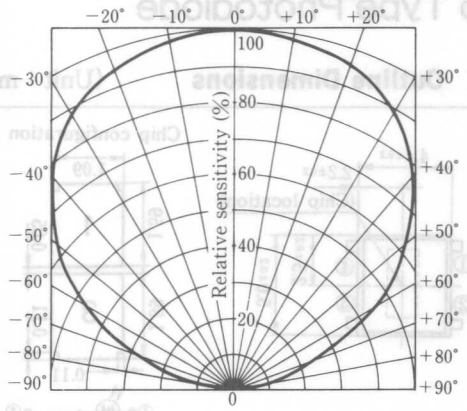
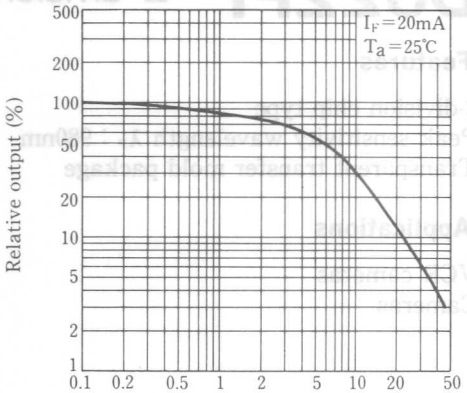


Fig. 7 Sensitivity Diagram (T_a=25°C)



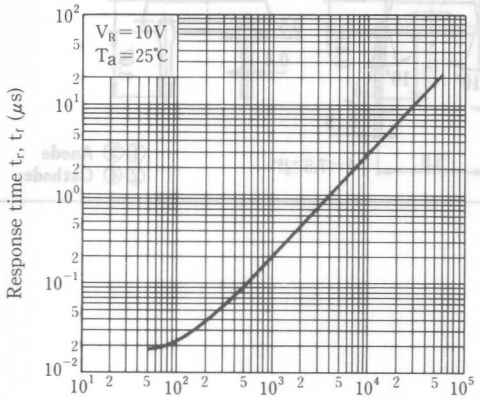
Angular displacement θ

Fig. 8 Relative Output vs. Distance (Emitter: GL521)



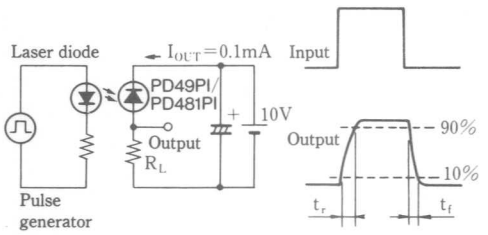
Distance to emitter d (mm)

Fig. 9 Response Time vs. Load Resistance



Load resistance R_L (Ω)

Test Circuit for Response Time



4

PD322PI 2-division Chip Type Photodiode

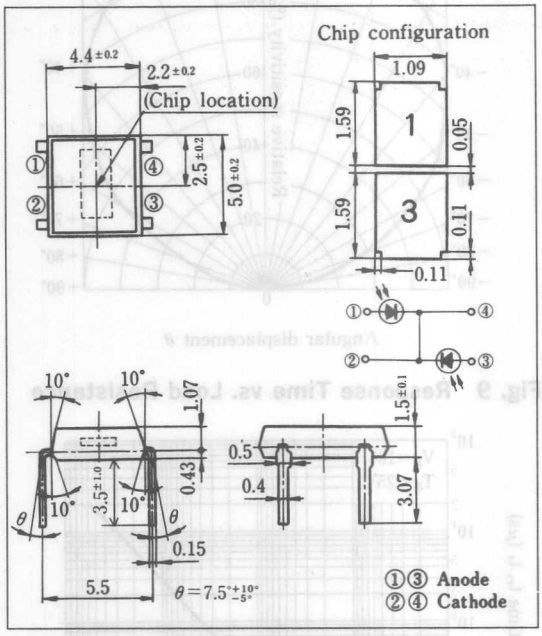
■ Features

1. 2-division chip type
2. Peak sensitivity wavelength λ_P : 980nm
3. Transparent transfer mold package

■ Applications

1. VCR cameras
2. Cameras

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	30	V
Power dissipation	P	100	mW
Oprating temperature	T_{opr}	−25～+80	°C
Storage temperature	T_{stg}	−40～+80	°C
*1Soldering temperature	T_{sol}	260	°C

*3 For 3 seconds at the position of 1mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Short circuit current	I_{sc}	*3E_v=100 ℓx	1.2	1.7	2.2	μA
Dark current	I_d	V_R=10V	—	—	20	nA
Terminal capacitance	C_t	V_R=10V, f=1MHz	—	5	15	pF
Peak sensitivity wavelength	λ_p		930	980	1,010	nm
Response time	t_r, t_f	V_R=10V, R_L=1kΩ	—	70	—	ns

*2 Values for 1 element. Measured with short-circuit between the anode and the cathode of non-measurement elements.

*3 E_v : Illuminance by CIE standard light source A (tungsten lamp)

Fig. 1 Power Dissipation vs. Ambient Temperature

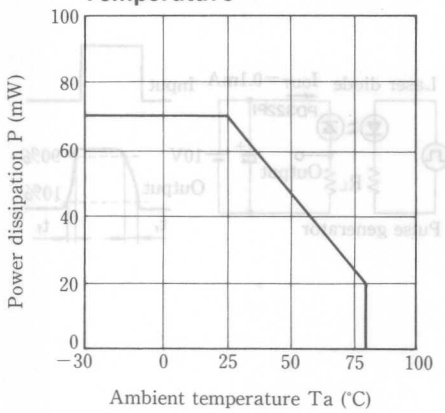


Fig. 2 Spectral Sensitivity

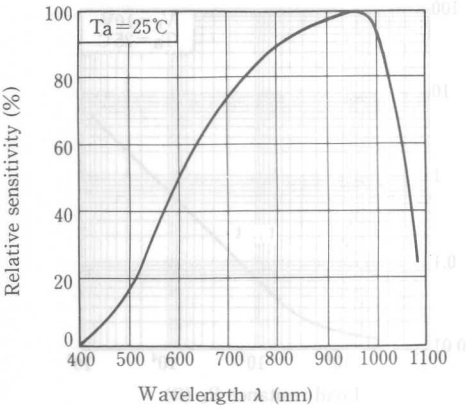


Fig. 3 Dark Current vs. Ambient Temperature

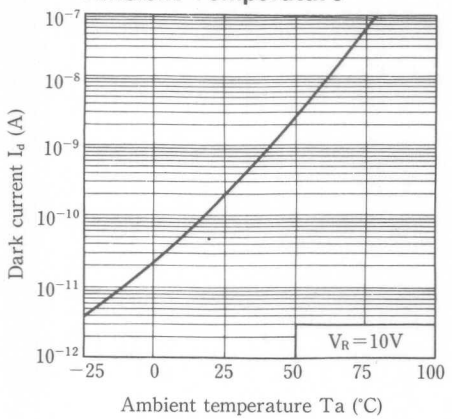


Fig. 4 Dark Current vs. Reverse Voltage

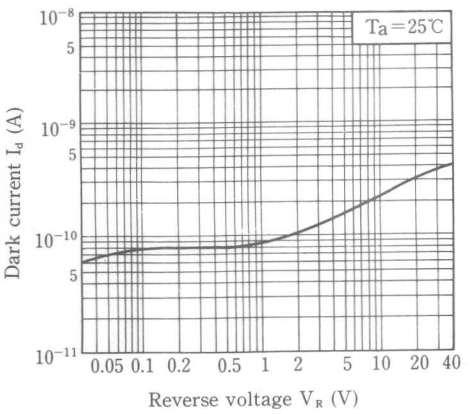


Fig. 5 Terminal Capacitance vs. Reverse Voltage

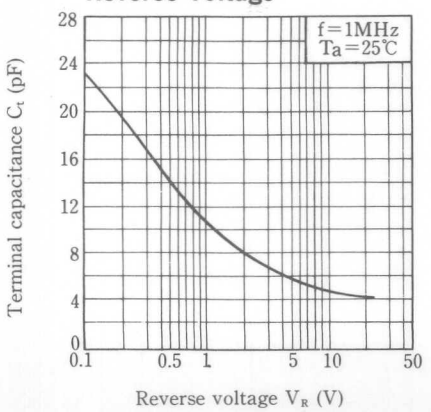
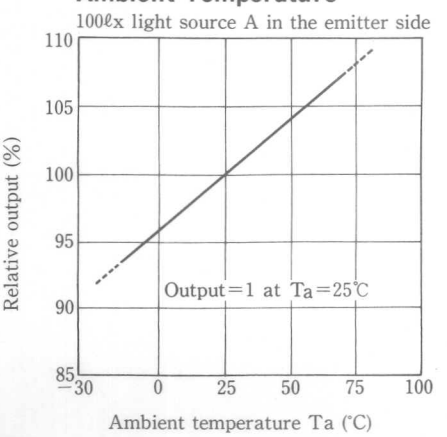
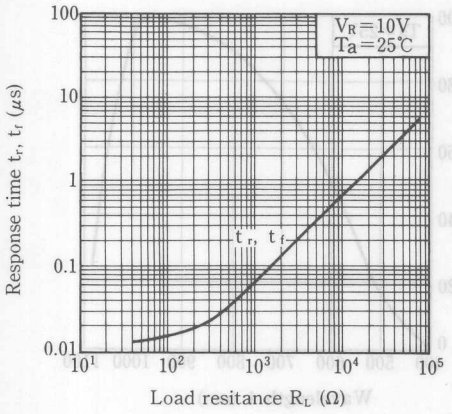


Fig. 6 Relative Output vs. Ambient Temperature

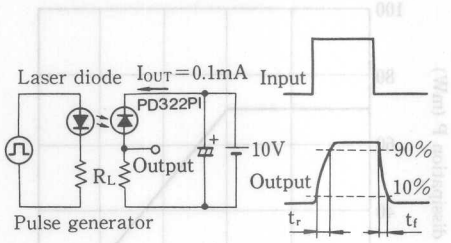


4

Fig. 7 Response Time vs. Load Resistance



Test Circuit for Response Time



PD410PI High Speed Photodiode

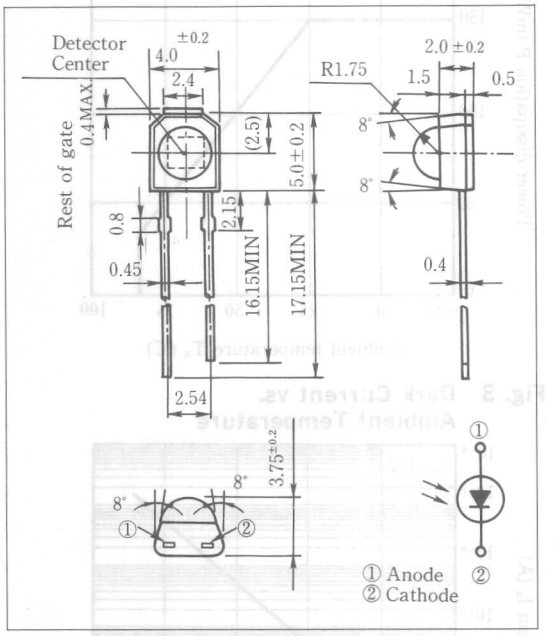
■ Features

1. Peak sensitivity wavelength matching with infrared LED (λp=1000nm)
2. Built-in visible light cut-off filter

■ Applications

1. Infrared remote controllers for TVs, VCRs, audio equipment and air conditioners, etc.

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	32	V
Power dissipation	P	150	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+100	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 2.3mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Coditions	MIN.	TYP.	MAX.	Unit
Short-circuit current	I_{SC}	E_V=100ℓx	2.5	3.0	—	μA
Short-circuit current temperature coefficient	B_T	E_V=100ℓx	—	0.2	—	%/°C
Dark current	I_d	V_R=10V, E_V=0	—	0.5	10	nA
Dark current temperature coefficient	α_T	V_R=10V, E_V=0	—	3.5	5.0	times/10°C
Terminal capacitance	C_t	V_R=3V, f=1MHz	—	20	35	pF
Peak sensitivity wavelength	λ_p	—	—	1000	—	nm
Peak spectral sensitivity	K	λ=1000nm	—	0.1	—	A/W
Half intensity angle	Δθ	—	—	±45	—	deg.
Response time	t_r, t_f	R_L=1kΩ, V_R=10V	—	200	—	ns

4

Fig. 1 Power Dissipation vs. Ambient Temperature

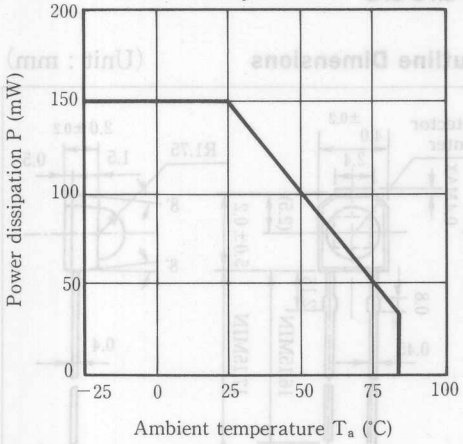


Fig. 2 Spectral Sensitivity

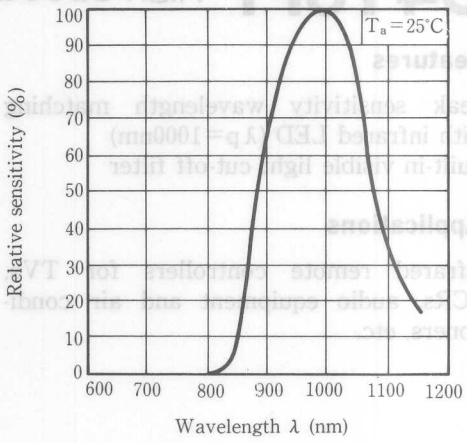


Fig. 3 Dark Current vs. Ambient Temperature

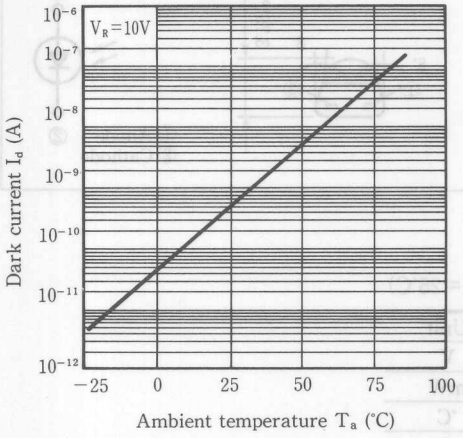


Fig. 4 Dark Current vs. Reverse Voltage

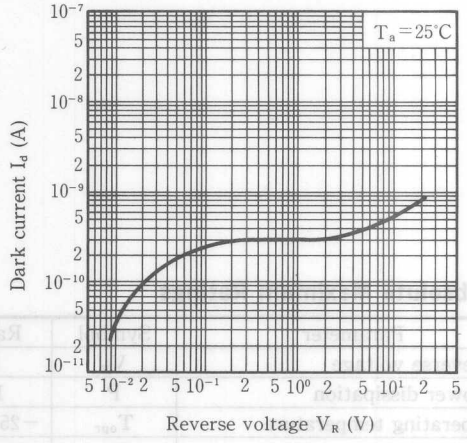


Fig. 5 Terminal Capacitance vs. Revere Voltage

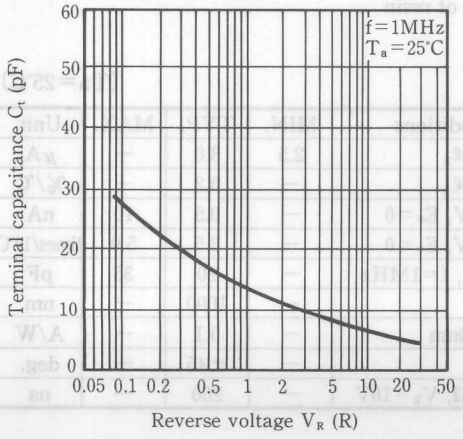


Fig. 6 Relative Output vs. Ambient Temperature (Emitter: GL522)

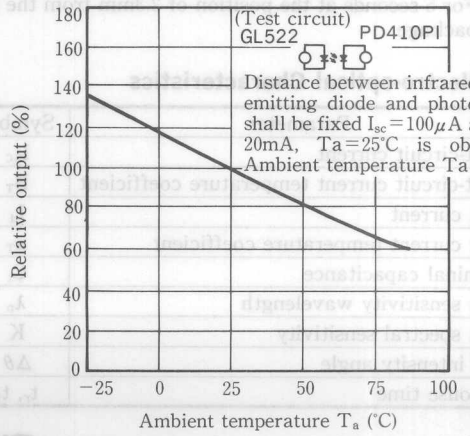
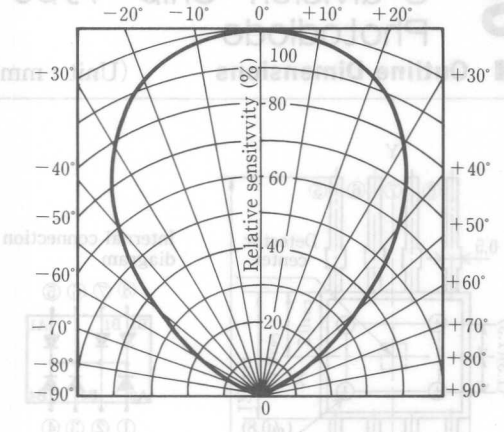
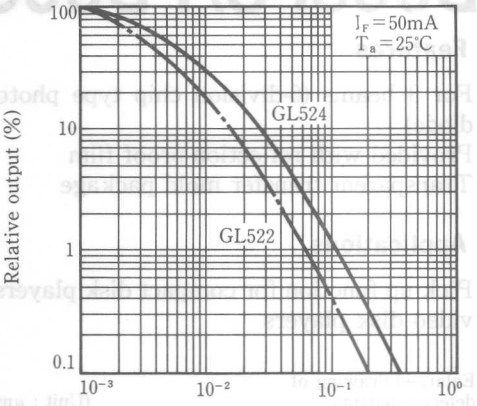


Fig.7 Sensitivity Diagram



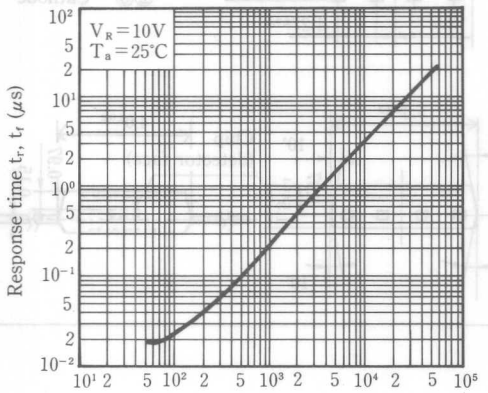
Angular displacement θ

Fig. 8 Relative Output vs. Distance (Emitter : GL522/GL524)



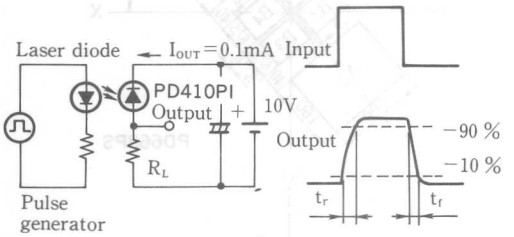
Distance to emitter d (mm)

Fig. 9 Response Time vs. Load Resistance



Load resistance R_L (Ω)

Test Circuit for Response Time



4

PD663PS/PD666PS 6-division Chip Type Photodiode

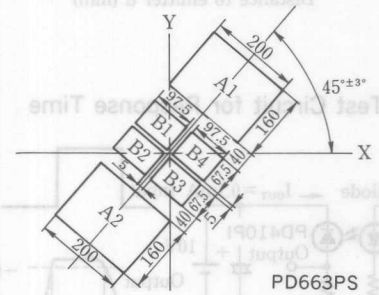
■ Features

1. For 3 beams (6-division chip type photodiode)
2. Provided with reflection-proof film
3. Transparent transfer mold package

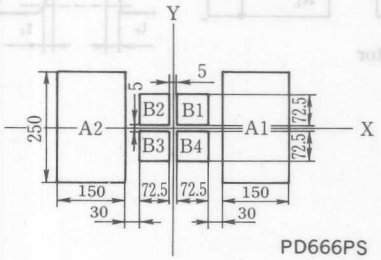
■ Applications

1. Pick-up function for compact disk players, video disk players

Enlarged drawing of detector portion (Unit : μm)

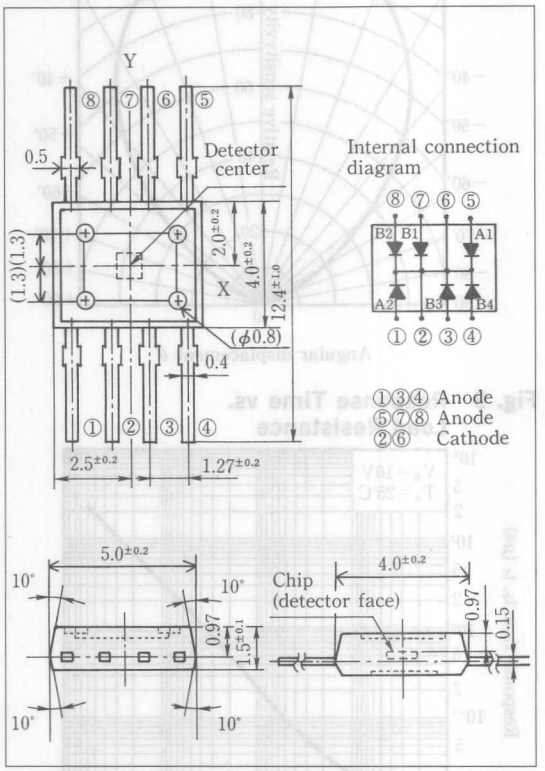


PD663PS



PD666PS

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	30	V
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*1Soldering temperature	T_{sol}	260	°C

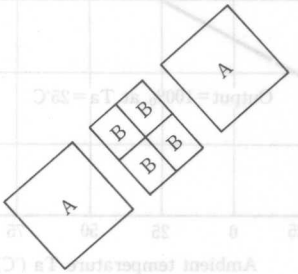
*1 For 3 seconds at the position of 1mm from the surface of resin edge

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	*6	MIN.	TYP.	MAX.	Unit
*2*3Short-circuit current	PD663PS	I_{SC}	*4E_V=1000 ℓ x	A	340	490	640	nA
				B	80	120	160	nA
	PD666PS			A	400	570	740	nA
				B	70	100	130	nA
Reverse voltage		V_R	I_R=10μA	A, B	30	—	—	V
*5Dark current		I_d	V_R=15V	A	—	—	300	pA
				B	—	—	200	pA
Terminal capacitance		Ct	V_R=15V f=1MHz	A	—	3	—	pF
				B	—	2	—	pF
Peak sensitivity wavelength		λ_P		A, B	—	840	—	nm
Cut-off frequency		f_C	V_R=10V, R_L=50Ω	A	—	35	—	MHz
				B	—	35	—	MHz
Sensitivity		S	λ=780nm	A, B	0.45	0.55	0.65	A/W

*2 Values for 1 element. Measured with short-circuit between the anode and the cathode of non-measurement elements.
*3 The short-circuit currents for the 2 chips at both ends and 4 chips at the center on the segment in one element shall be within ±10% of the average for each of them.
*4 E_V : Illuminance by CIE standard light source A (tungsten lamp)
*5 Values for 1 element
*6 Symbols correspond to the elements of same symbols of detector portion in the drawing below.

PD663PS



PD666PS

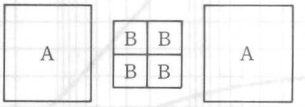


Fig. 1 Power Dissipation vs. Ambient Temperature

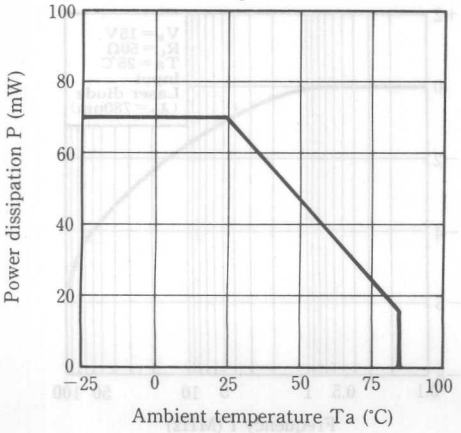


Fig. 2 Spectral Sensitivity

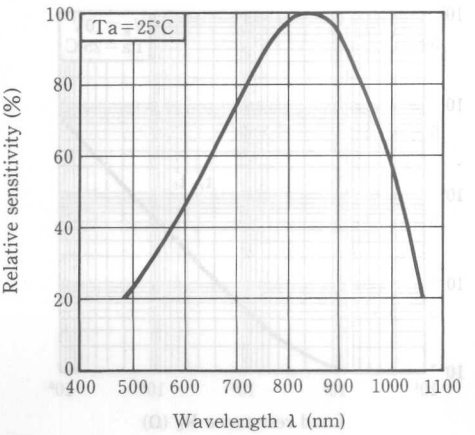


Fig. 3 Dark Current vs. Ambient Temperature

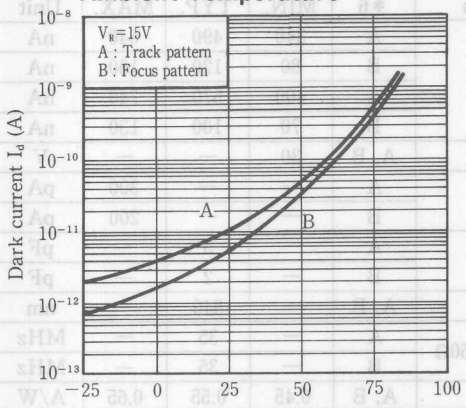


Fig. 4 Dark Current vs. Reverse Voltage

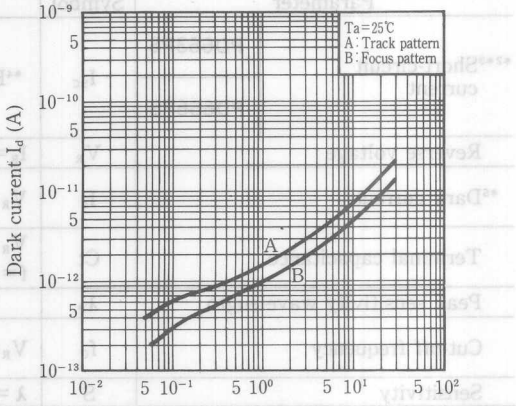


Fig. 5 Terminal Capacitance vs. Reverse Voltage

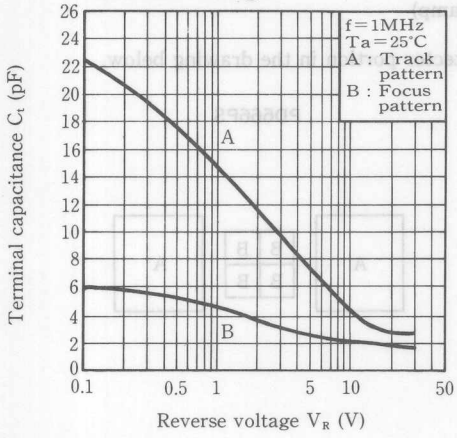


Fig. 6 Relative Output vs. Ambient Temperature

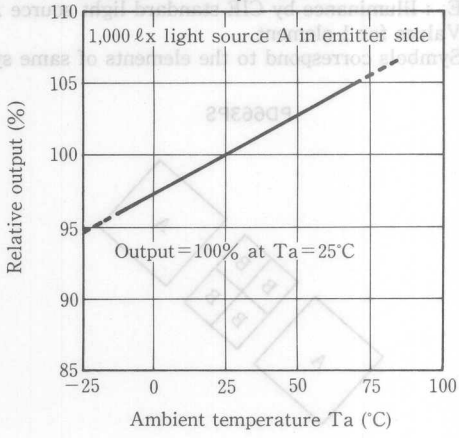


Fig. 7 Response Time vs. Load Resistance

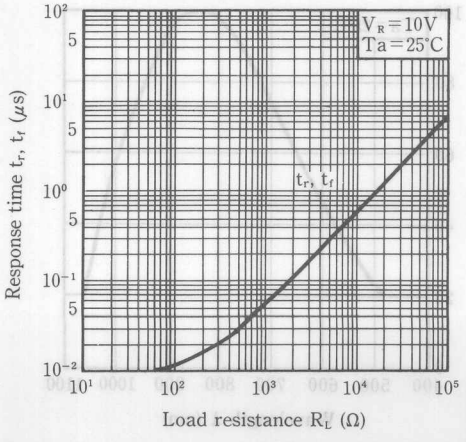
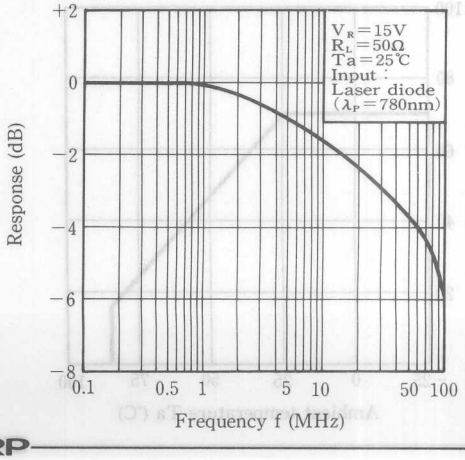


Fig. 8 Cut-off Frequency



BS100C Photodiode for Visible Light

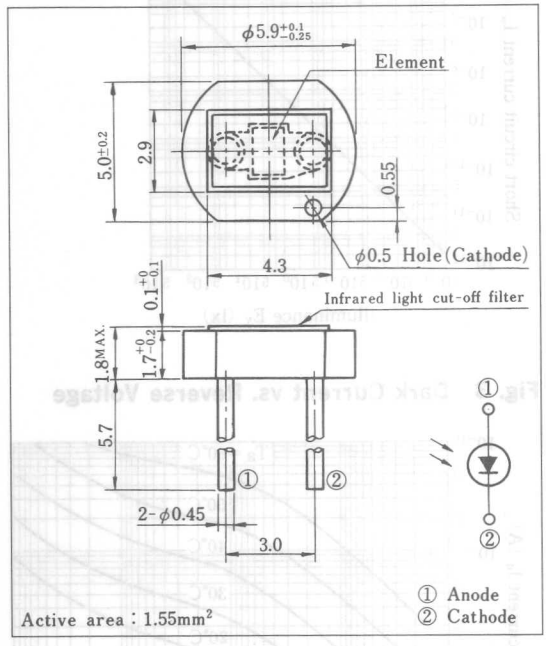
■ Features

1. Wide dynamic range
   (Capable of $E_V=10^{-3}\sim10^{4}\ell x$ range measurement)
2. Low dark current
   (I_d : MAX. 10^{-11}A at $V_R=1V$)
3. Infrared light cut-off type

■ Applications

1. AE (automatic exposure) system and ES (electronic shutter) system for cameras
2. Precise optical instruments

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings ($T_a=25°C$)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	10	V
Operating temperature	T_{opr}	−20～+60	°C
Storage temperature	T_{stg}	−30～+80	°C
*1 Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds

■ Electoro-optical Characteristics ($T_a=25°C$)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2 Short circuit current	I_{sc}	$E_V=100\ \ell x$	0.14	0.16	0.21	μA
*2 Short circuit current temperature coefficient	β_T	$E_V=100\ \ell x$	—	0.02	0.07	%/°C
Dark current	I_d	$V_R=1V$	—	3×10^{-12}	10^{-11}	A
Dark current temperature coefficient	α_T	$V_R=1V$	—	3.5	5.0	times/10°C
Terminal capacitance	C_t	$V_R=0$, f=1MHz	—	—	500	pF
Peak sensitivity wavelength	λ_p		500	560	600	nm
*3 Spectral sensitivity infrared radiation ratio	ΔI_R		—	6	10	%

*2 Ev : Illuminance by CIE standard light source A (tungsten lamp)

*3 $\Delta I_R=\dfrac{I_{sc}(\lambda\geqq700nm)}{I_{sc}(\text{full wavelength})}\times100\%$

4

Fig. 1 Short Circuit Current vs. Illuminance

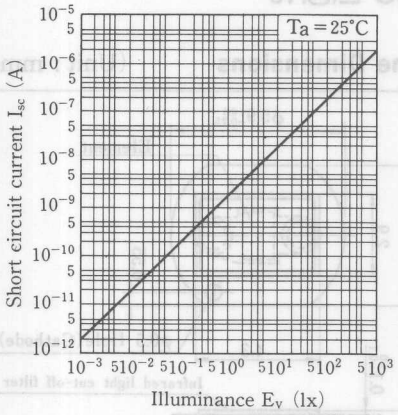


Fig. 2 Short Circuit Current vs. Ambient Temperature

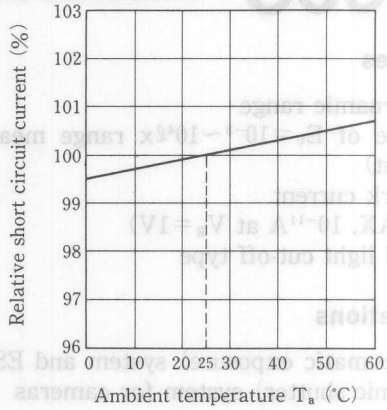


Fig. 3 Dark Current vs. Reverse Voltage

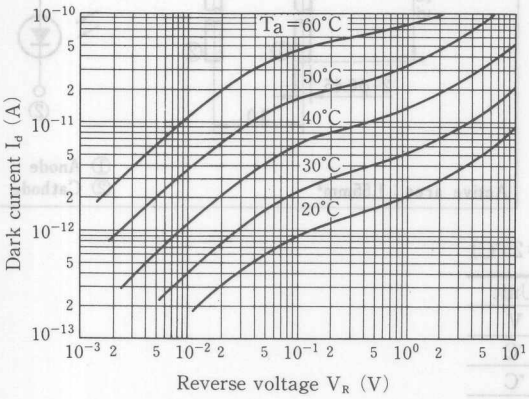


Fig. 4 Spectral Sensitivity

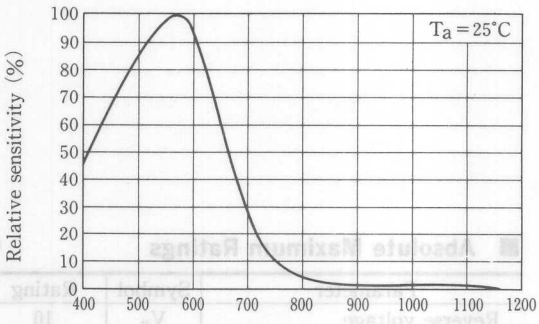
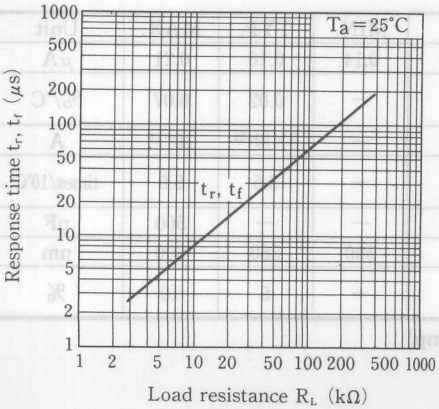
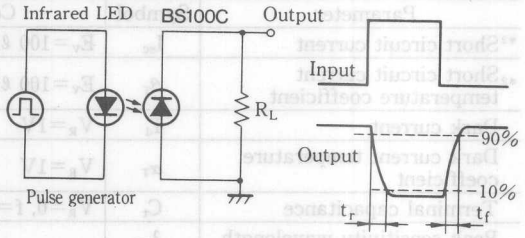


Fig. 5 Response Time vs. Load Resistance



Test Circuit for Response Time



BS100D Wide Wavelength Band Type Photodiode

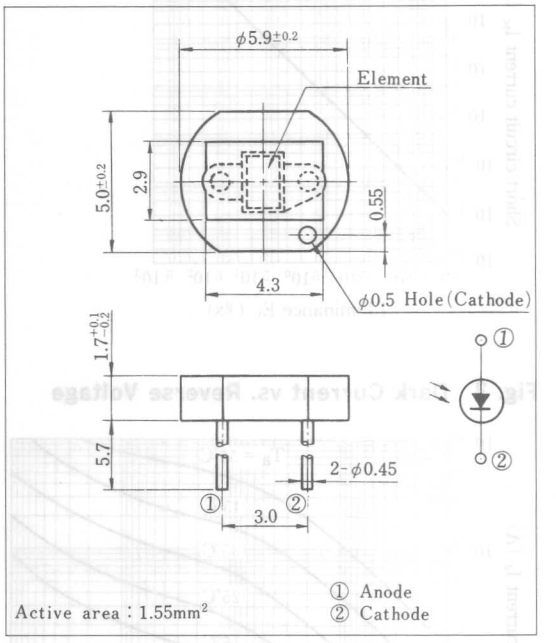
■ Features

1. Wide dynamic range
   (Capable of $E_V = 10^{-3} \sim 10^4 \ell x$ range measurament)
2. Very low dark current
   (I_d: MAX. 10^{-10} A at $V_R = 1V$)
3. A wide range of sensitivity wavelength

■ Applications

1. AE (automatic exposure) systems and ES (electronicshutter) system for cameras
2. Precise optical instruments

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings ($T_a = 25°C$)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	10	V
Operating temperature	T_{opr}	−10 ~ +60	°C
Storage temperature	T_{stg}	−20 ~ +80	°C
*1 Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics ($T_a = 25°C$)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2 Short circuit current	I_{sc}	Ev = 100 ℓx	0.80	1.05	1.50	μA
*2 Short circuit current temperature coefficient	β_T	$E_V = 100 \ell x$	—	0.2	—	%/°C
Dark current	I_d	$V_R = 1V$	—	5×10^{-12}	10^{-10}	A
Dark current temperature coefficient	α_T	$V_R = 1V$	—	3.5	5.0	times/10°C
Terminal capacitance	C_t	$V_R = 0$, f = 1MHz	—	—	500	pF
Peak sensitivity wavelength	λ_p		—	880	—	nm

*2 E_V : Illuminance by CIE standard light source A (tungsten lamp)

4

Fig. 1 Short Circuit Current vs. Illuminance

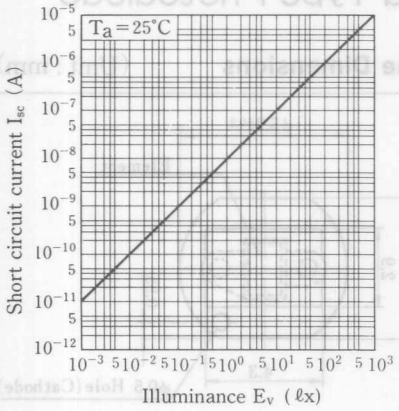


Fig. 2 Relative Short Circuit Current vs. Ambient Temperature

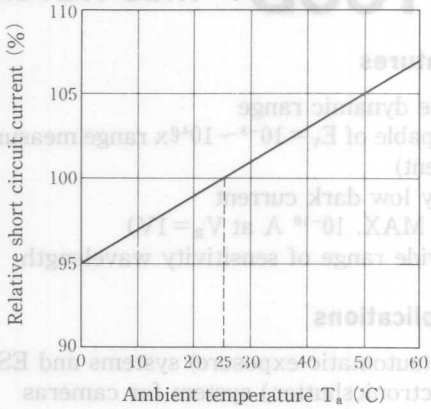


Fig. 3 Dark Current vs. Reverse Voltage

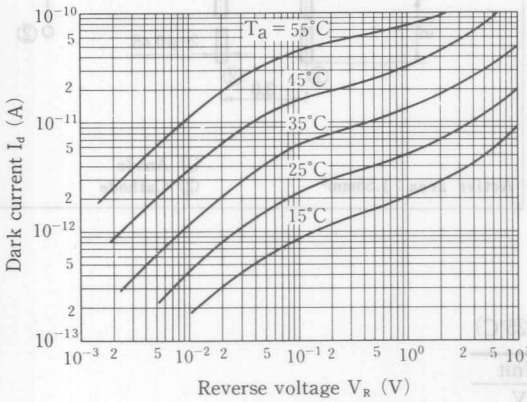


Fig. 4 Spectral Sensitivity

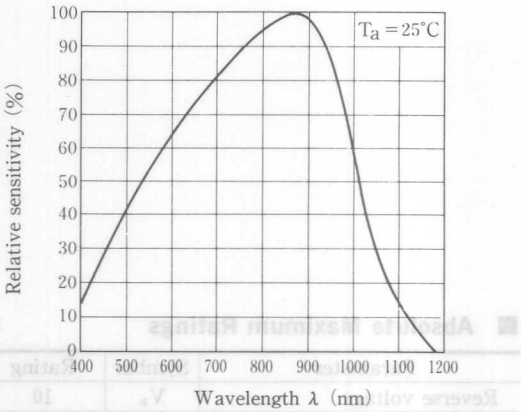
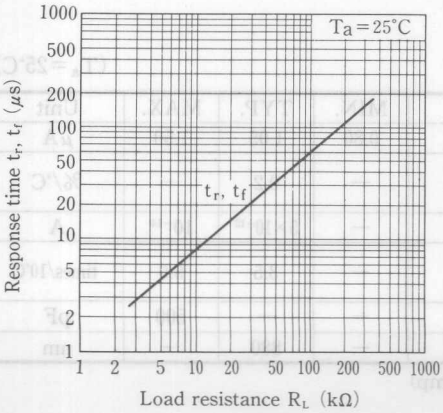
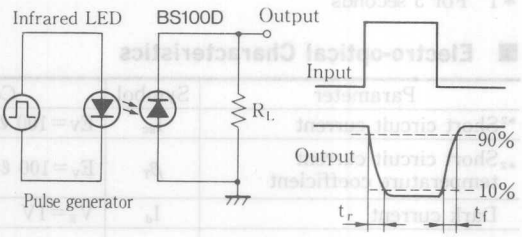


Fig. 5 Response Time vs. Load Resistance



Test Circuit for Response Time



BS112/BS142 Wide Wavelength Band Type Photodiode

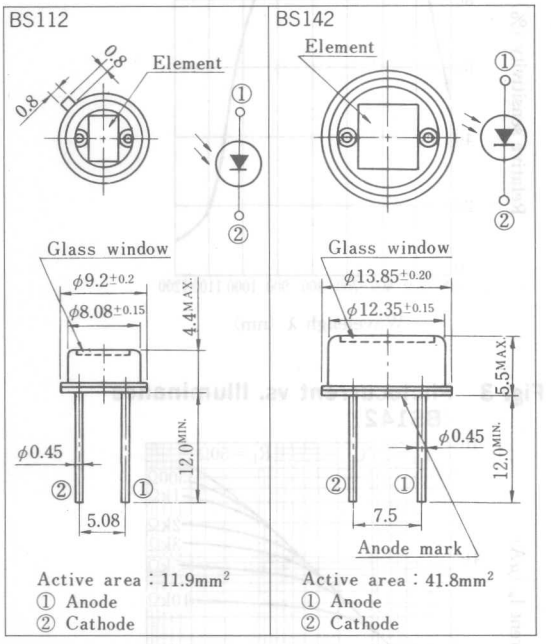
■ Features

1. A wide range of sensitivity wavelength (λ : 350~1,150nm)
2. High reliability (hermetic seal package)
3. High sensitivity (BS112 I_{sc} : MIN. 5.5μA, BS142 I_{sc} : MIN. 18μA at E_V=100ℓx)

■ Applications

1. Illuminance meters
2. Scientific color measuring instruments, such as colorimeters, flame color meters, analyzers and spectral photo meters
3. Precise optical instruments

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	BS112	BS142	Unit
Reverse voltage	V_R	5	5	V
Operating temperature	T_{opr}	−10~+60	−10~+60	°C
Storage temperature	T_{stg}	−20~+80	−20~+80	°C
*1Soldering temperature	T_{sol}	260	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	BS112			BS142			Unit
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
*2Open circuit voltage	V_{oc}	E_V=100 ℓx	0.25	0.32	—	0.25	0.32	—	V
*2Short circuit current	I_{sc}	E_V=100 ℓx	5.5	7.0	—	18	22	—	μA
Dark current	I_d	V_R=1V	—	5×10^{-9}	10^{-7}	—	5×10^{-9}	10^{-7}	A
Peak sensitivity wavelength	λ_p		—	850	—	—	850	—	nm
Sensitivity wavelength width	λ		350	—	1,150	350	—	1,150	nm
Response time	t_r, t_f	R_L=1kΩ	—	20	—	—	27	—	μs

*2 Ev : Illuminance by CIE standard light source A (tungsten lamp)

4

Fig. 1 Spectral Sensitivity

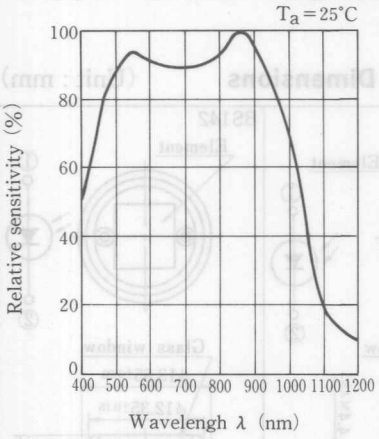


Fig. 2 Photocurrent vs. Illuminance (BS112)

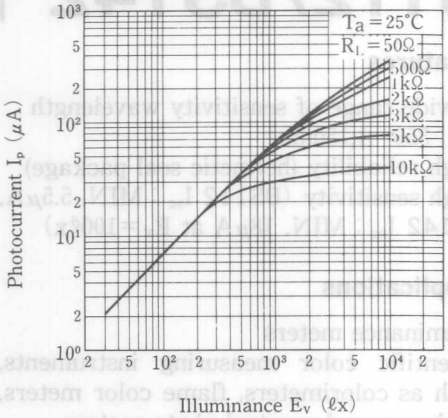


Fig. 3 Photocurrent vs. Illuminance (BS142)

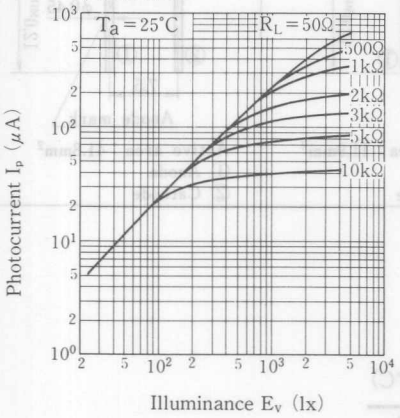


Fig. 4 Photocurrent vs. Forward Voltage (BS112)

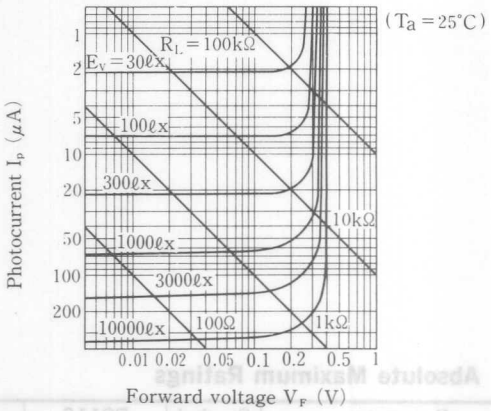


Fig. 5 Photocurrent vs. Forward Voltage (BS142)

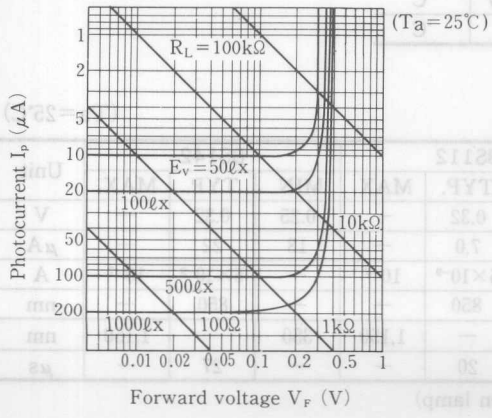


Fig. 6 Short Circuit Current, Open Circuit Voltage vs. Ambient Temperature

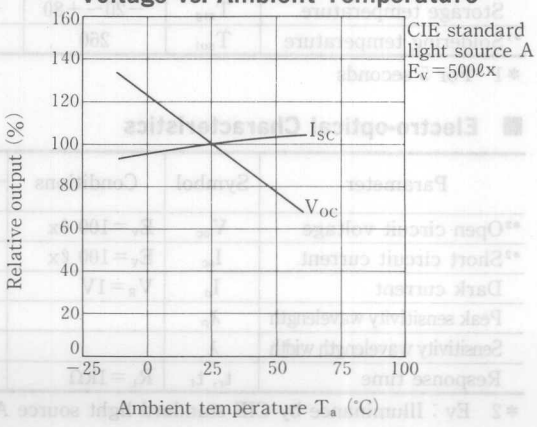


Fig. 7 Dark Current vs. Reverse Voltage (BS112)

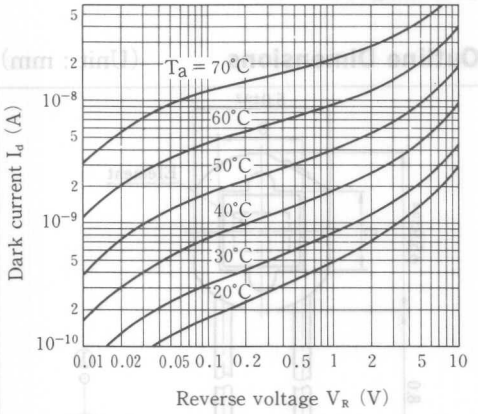


Fig. 8 Dark Current vs. Reverse Voltage (BS142)

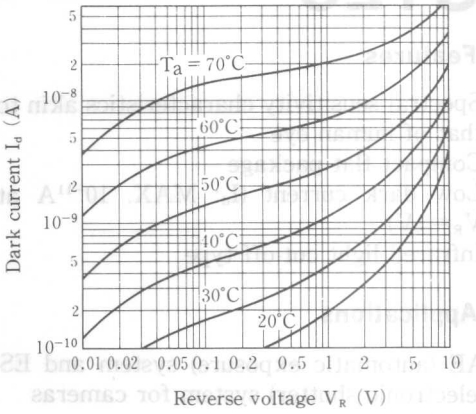


Fig. 9 Response Time vs. Load Resistance (BS112)

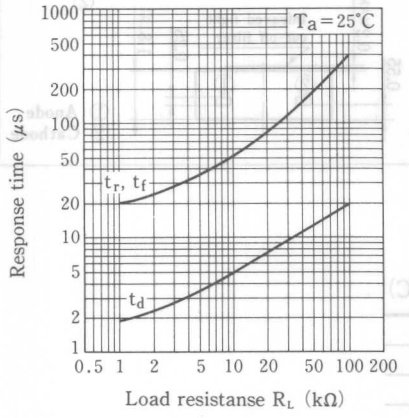
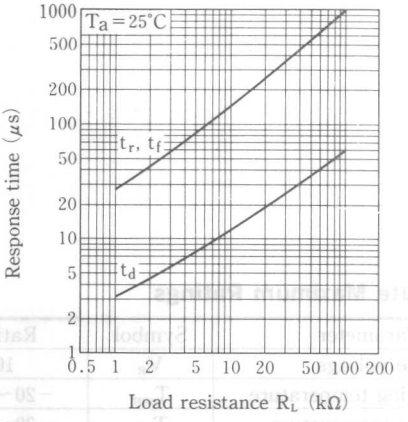
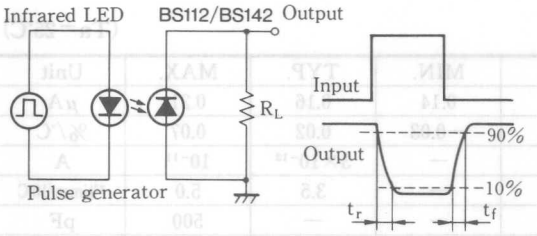


Fig. 10 Response Time vs. Load Resistance (BS142)



Test Circuit for Response Time



4

BS120 Photodiode for Visible Light

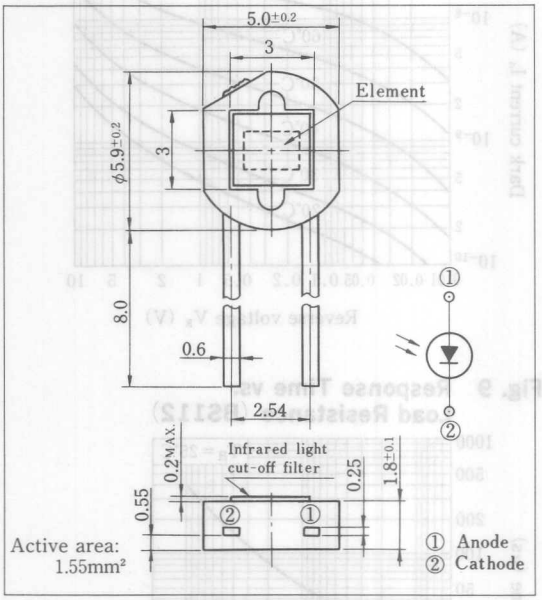
■ Features

1. Spectral sensitivity characteristics akin to that of human eye
2. Compact flat package
3. Low dark current (I_d: MAX. 10^{-11}A at V_R=1V)
4. Infrared light cut-off type

■ Applications

1. AE (automatic exposure) system and ES (electronic shutter) system for cameras
2. Stroboscopes
3. Precise optical instruments

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	10	V
Operating temperature	T_{opr}	−20～+60	°C
Storage temperature	T_{stg}	−30～+80	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Short circuit current	I_{SC}	E_V=100ℓx	0.14	0.16	0.21	μA
*2Short circuit current temperature coefficient	β_T	E_V=100ℓx	−0.03	0.02	0.07	%/°C
Dark current	I_d	V_R=1V	—	3×10^{-12}	10^{-11}	A
Dark current temperature coefficient	α_T	V_R=1V	—	3.5	5.0	*3times/10°C
Terminal capacitance	C_t	V_R=0, f=1MHz	—	—	500	pF
Peak sensitivity wavelength	λ_p		500	560	600	nm
Spectral sensitivity infrared radiation ratio	$\triangle I_R$		—	6	10	%

*2 E_V: Illuminance by CIE standard light source A (tungsten lamp)

*3 times/10°C

*4 $\triangle I_R = \frac{I_{SC}\ (\lambda \geqq 700\text{nm})}{I_{SC}\ (\text{full wavelength})} \times 100\%$

Fig. 1 Short Circuit Current vs. Illuminance

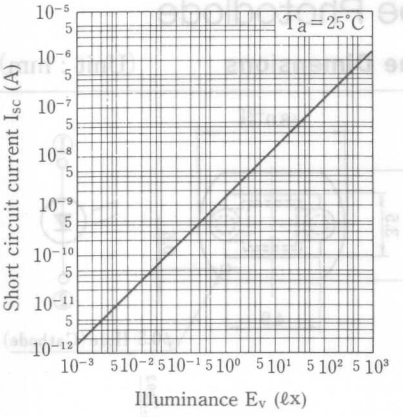


Fig. 2 Relative Short Circuit Current vs. Ambient Temperature

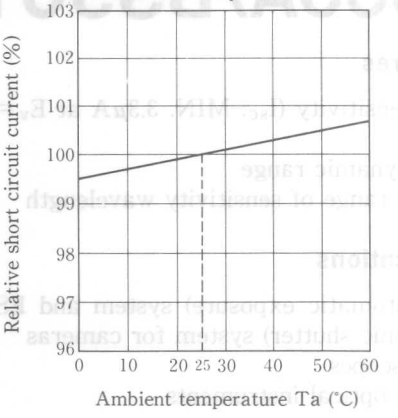


Fig. 3 Dark Current vs. Reverse Voltage

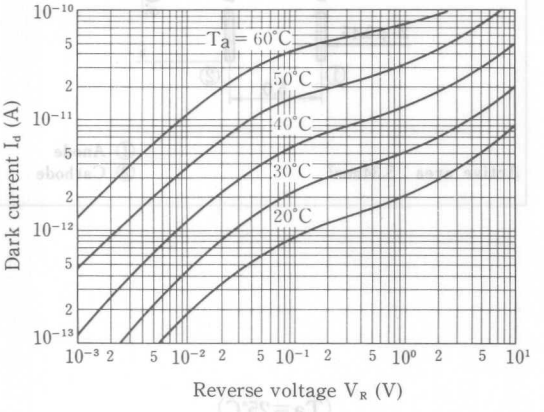


Fig. 4 Spectral Sensitivity

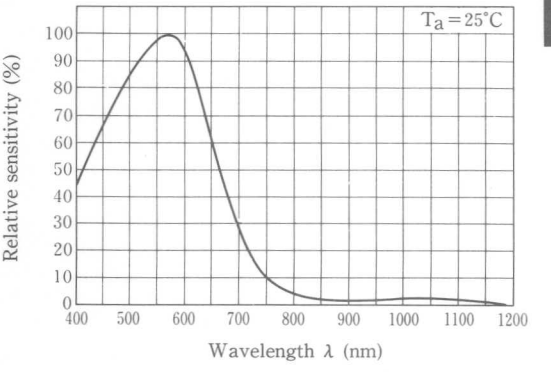
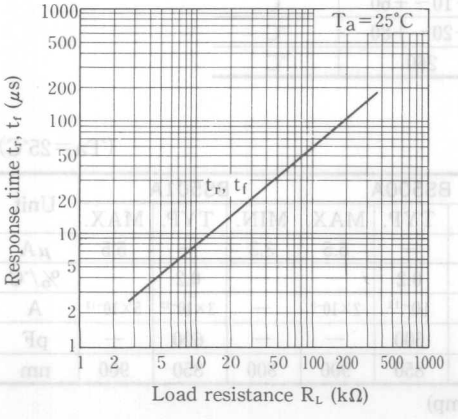
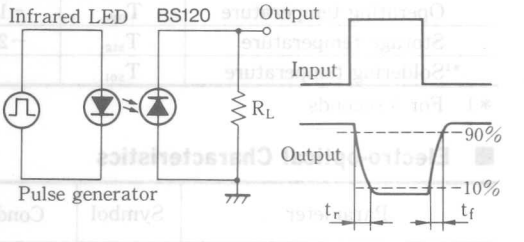


Fig. 5 Response Time vs. Load Resistance



Test Circuit for Response Time



BS500A/BS501A Wide Wavelength Band Type Photodiode

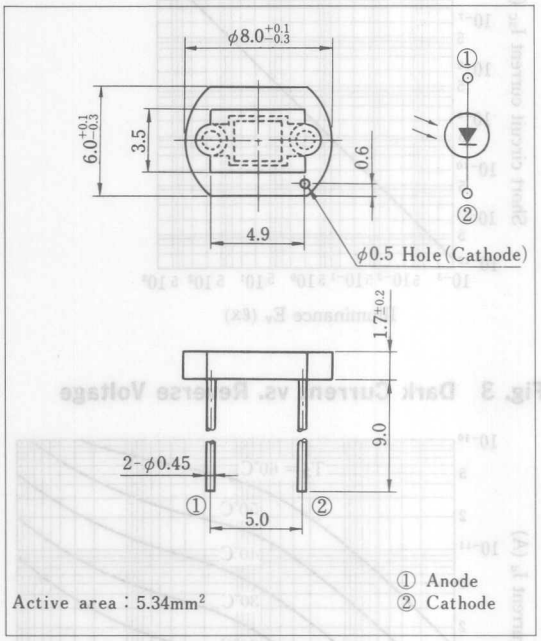
■ Features

1. High sensitivity (I_{SC}: MIN. 3.3μA at E_V= 100 ℓx)
2. Wide dynamic range
3. A wide range of sensitivity wavelength

■ Applications

1. AE (automatic exposure) system and ES (electronic shutter) system for cameras
2. Stroboscopes
3. Precise optical instruments

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	BS500A	BS501A	Unit
Reverse voltage	V_R	10	10	V
Operating temperature	T_{opr}	−10～+60	−10～+60	°C
Storage temperature	T_{stg}	−20～+80	−20～+80	°C
*1Soldering temperature	T_{sol}	260	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	BS500A			BS501A			Unit
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
*2Short circuit current	I_{SC}	E_V=100ℓx	3.3	—	5.5	3.3	—	5.5	μA
*2Short circuit current temperature coefficient	β_T	E_V=100ℓx	—	0.2	—	—	0.2	—	%/°C
Dark current	I_d	V_R=2V	—	10^{-11}	2×10^{-9}	—	3×10^{-12}	5×10^{-12}	A
Terminal capacitance	C_t	V_R=0, f=1MHz	—	600	—	—	600	—	pF
Peak sensitivity wavelength	λ_p		800	850	900	800	850	900	nm

*2 E_V: Illuminance by CIE standard light source A (tungsten lamp)

Fig. 1 Short Circuit Current vs. Illuminance

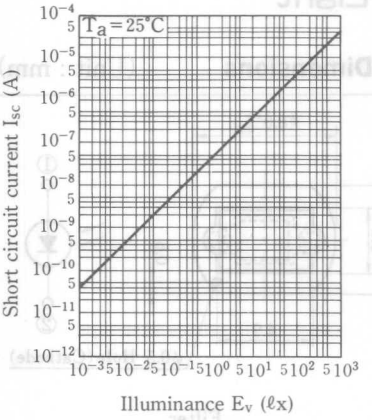


Fig. 2 Relative Short Circuit Current vs. Ambient Temperature

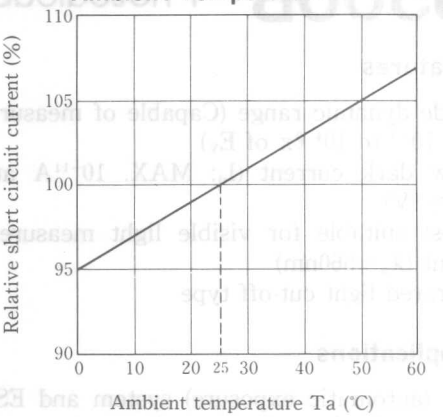


Fig. 3 Dark Current vs. Reverse Voltage

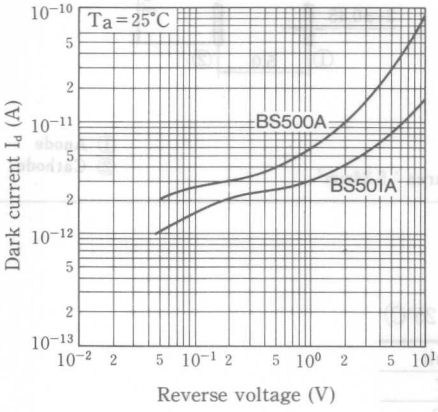


Fig. 4 Spectral Sensitivity

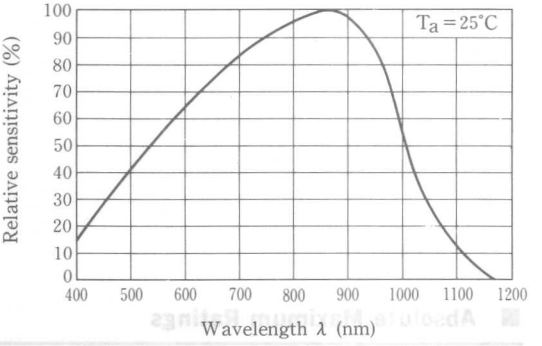
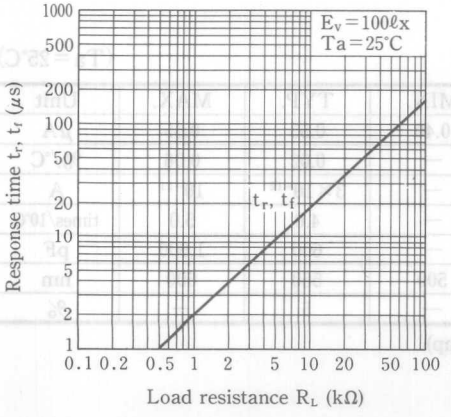
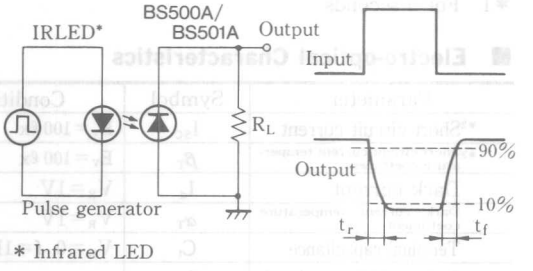


Fig. 5 Response Time vs. Load Resistance



Test Circuit for Response Time



BS500B Photodiode for Visible Light

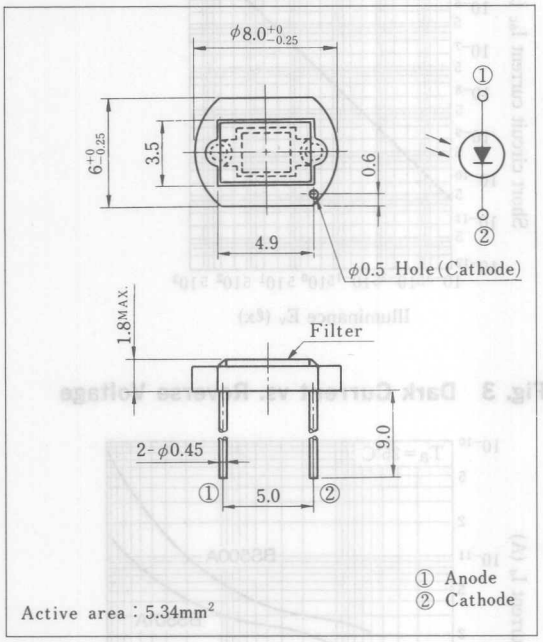
■ Features

1. Wide dynamic range (Capable of measuring 10^{-3} to 10^{4} ℓx of E_V)
2. Low dark current (I_d: MAX. 10^{-11}A at V_R=1V)
3. Most suitable for visible light measurement (λ_p=560nm)
4. Infrared light cut-off type

■ Applications

1. AE (automatic exposure) system and ES (electronic shutter) system for cameras
2. Stroboscopes
3. Precise optical instruments

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	10	V
Operating temperature	T_{opr}	−20～+60	°C
Storage temperature	T_{stg}	−20～+80	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Short circuit current	I_{SC}	E_V=100 ℓx	0.40	0.55	0.65	μA
*2Short circuit current temperature coefficient	β_T	E_V=100 ℓx	—	0.02	0.06	%/°C
Dark current	I_d	V_R=1V	—	3×10^{-12}	10^{-11}	A
Dark current temperature coefficient	α_T	V_R=1V	—	4.0	5.0	times/10°C
Terminal capacitance	C_t	V_R=0, f=1MHz	—	600	1,000	pF
Peak sensitivity wavelength	λ_p		500	560	600	nm
*3Spectral sensitivity infrared radiation ratio	$\triangle I_R$		—	5	—	%

*2 E_V: Illuminance by CIE standard light source A (tungsten lamp)

*3 $\triangle I_R = \dfrac{I_{SC}\ (\lambda \geqq 700\text{nm})}{I_{SC}\ (\text{full wavelength})} \times 100\%$

Fig. 1 Short Circuit Current vs. Illuminance

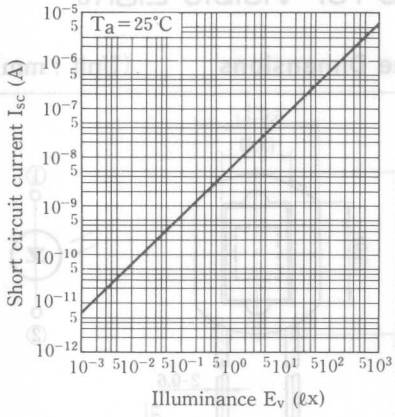


Fig. 2 Relative Short Circuit Current vs. Ambient Temperature

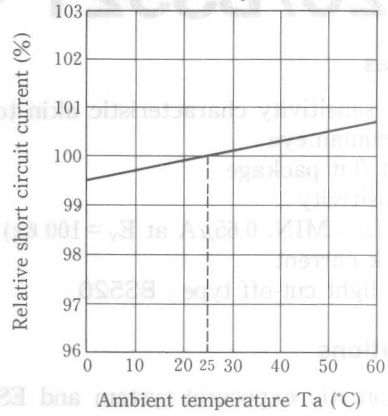


Fig. 3 Dack Current vs. Reverse Voltage

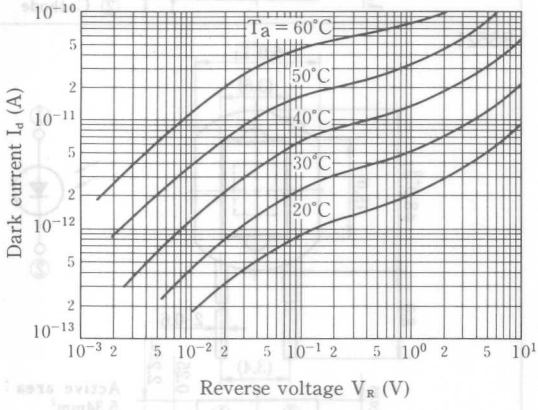


Fig. 4 Spectral Sensitivity

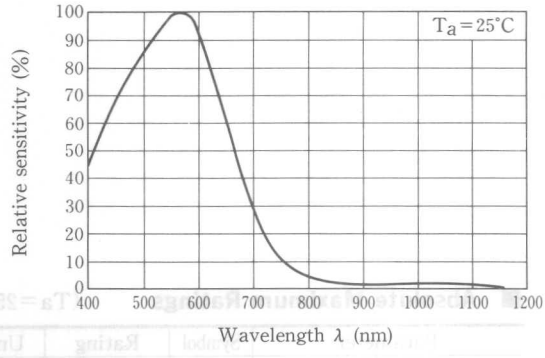
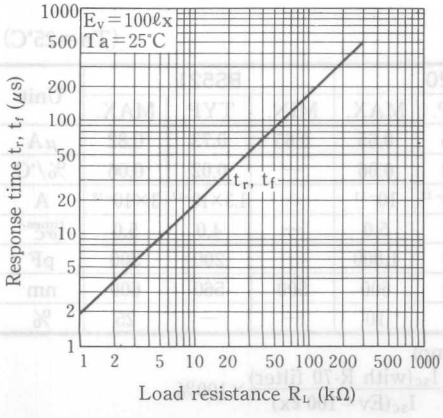
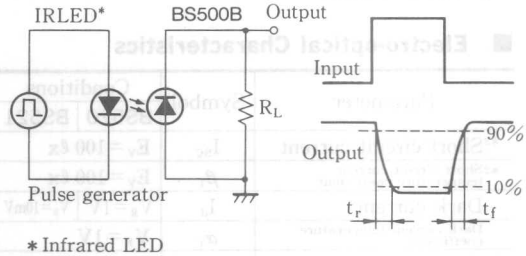


Fig. 5 Response Time vs. Load Resistance



Test Circuit for Response Time



* Infrared LED

4

BS520/BS521 Photodiode for Visible Light

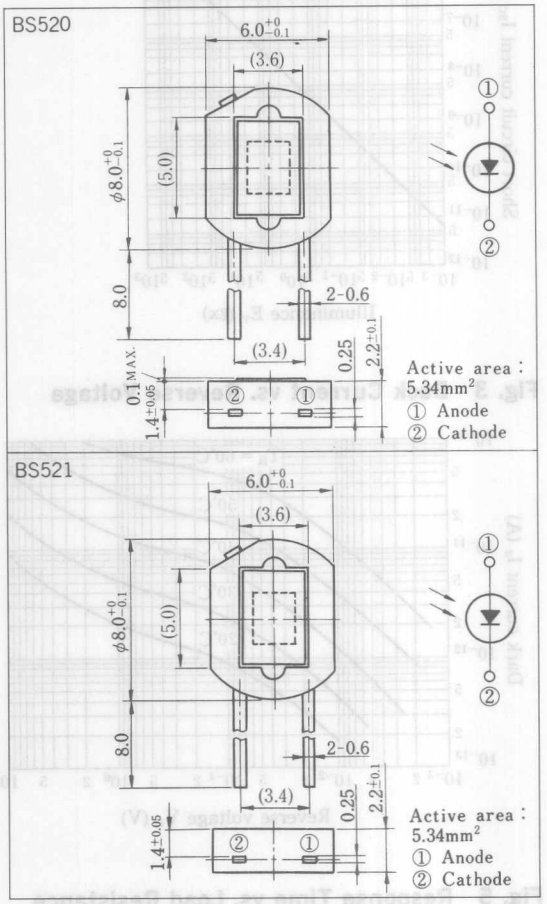
■ Features

1. Spectral sensitivity characteristic akin to that of human eye
2. Compact flat package
3. High sensitivity
   (BS521 I_{SC} : MIN. 0.65μA at E_V=100 ℓx)
4. Low dark current
5. Infrared light cut-off type : BS520

■ Applications

1. AE (automatic exposure) system and ES (electronic shutter) system for cameras
2. Stroboscopes
3. Precise optical instruments

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	10	V
Operating temperature	T_{opr}	−20 ~ +60	°C
Storage temperature	T_{stg}	−30 ~ +80	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions BS520	Conditions BS521	BS520 MIN.	BS520 TYP.	BS520 MAX.	BS521 MIN.	BS521 TYP.	BS521 MAX.	Unit
*2Short circuit current	I_{SC}	E_V=100 ℓx		0.40	0.55	0.65	0.65	0.73	0.82	μA
*2Short circuit current temperature coefficient	β_T	E_V=100 ℓx		—	0.02	0.06	—	0.02	0.06	%/°C
Dark current	I_d	V_R=1V	V_R=10mV	—	3×10^{-12}	10^{-11}	—	1.3×10^{-12}	3×10^{-12}	A
Dark current temperature coefficient	α_T	V_R=1V		—	4.0	5.0	—	4.0	5.0	times/10°C
Terminal capacitance	C_t	V_R=0, f=100kHz		—	600	1,000	—	200	300	pF
Peak sensitivity wavelength	λ_p			500	560	600	500	560	600	nm
*3Spectral sensitivity infrared radiation ratio	ΔI_R			—	5	10	—	—	25	%

*2 Ev : Illuminance by CIE standard light source A (tungsten lamp)

*3 BS520 : $\Delta I_R = \frac{I_{SC}(\lambda \geqq 700nm)}{I_{SC}(\text{entire wavelength})} \times 100\%$ BS521 : $\Delta I_R = \frac{I_{SC}(\text{with R-70 filter})}{I_{SC}(Ev=100\ \ell x)} \times 100\%$

Fig. 1 Short Circuit Current vs. Illuminance

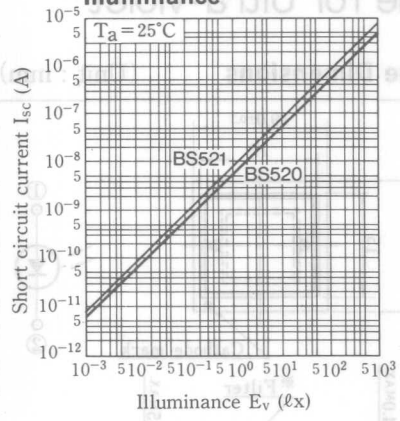


Fig. 2 Relative Short Circuit Current vs. Ambient Temperature

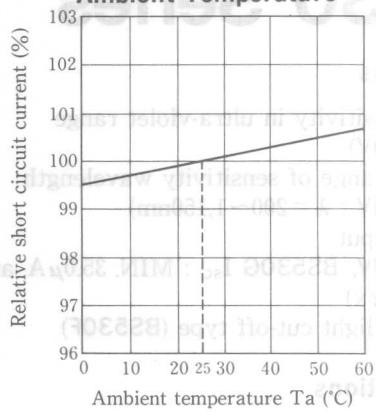


Fig. 3 Dark Current vs. Reverse Voltage (BS520)

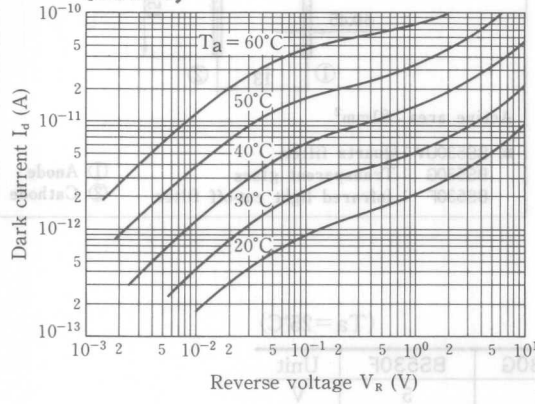


Fig. 4 Dark Current vs. Reverse Voltage (BS521)

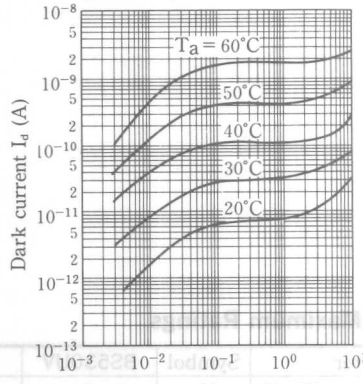


Fig. 5 Spectral Sensitivity

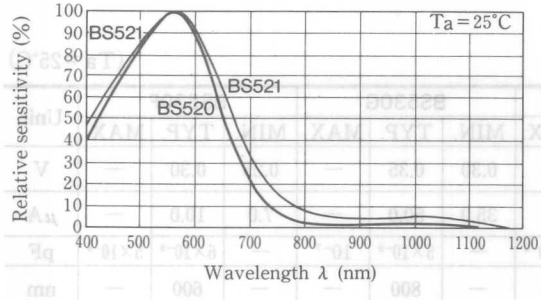
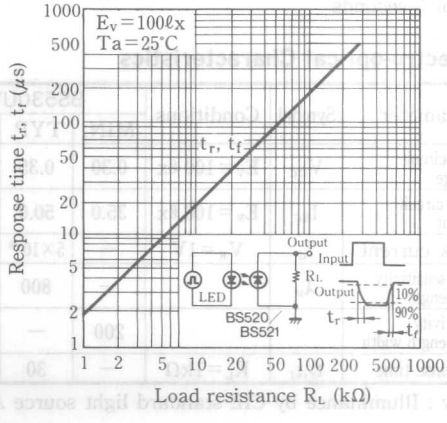


Fig. 6 Response Time vs. Load Resistance



4

BS530 Series Photodiode for Ultra-violet

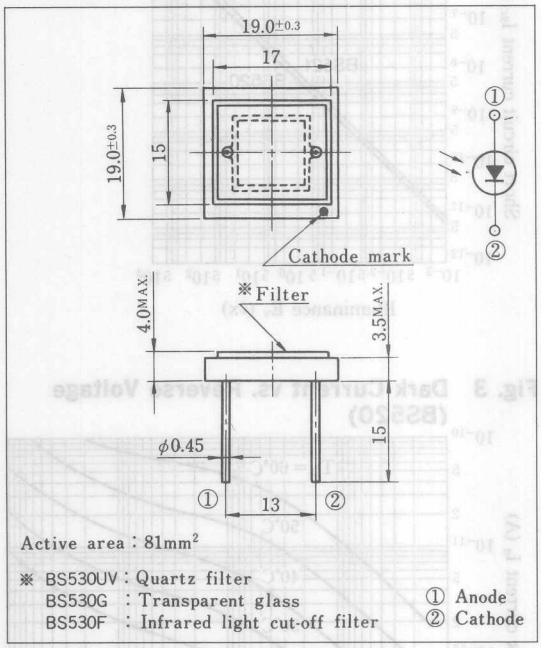
■ Features

1. High sensitivity in ultra-violet range (BS530UV)
2. A wide range of sensitivity wavelength (BS530UV : λ = 200 ~ 1,150nm)
3. High output (BS530UV, BS530G I_{SC} : MIN. 35.0μA at E_V = 100 ℓx)
4. Infrared light cut-off type (BS530F)

■ Applications

1. BS530UV : Spectrophotometers
2. BS530F : Color analysis for color copiers
3. BS530G : Illuminance meters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	BS530UV	BS530G	BS530F	Unit
Reverse voltage	V_R	5	5	5	V
Operating temperature	T_{opr}	−10 ~ +60	−10 ~ +60	−10 ~ +60	°C
Storage temperature	T_{stg}	−20 ~ +80	−20 ~ +80	−20 ~ +80	°C
*1Soldering temperature	T_{sol}	260	260	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics (Ta = 25°C)

Parameter	Symbol	Conditions	BS530UV			BS530G			BS530F			Unit
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
*2Open circuit voltage	V_{OC}	E_V = 100 ℓx	0.30	0.35	—	0.30	0.35	—	0.25	0.30	—	V
*2Short circuit current	I_{SC}	E_V = 100 ℓx	35.0	50.0	—	35.0	50.0	—	7.0	10.0	—	μA
Dark current	I_d	V_R = 1V	—	5×10^{-9}	5×10^{-8}	—	5×10^{-9}	10^{-7}	—	6×10^{-9}	5×10^{-8}	pF
Peak sensitivity wavelength	λ_p		—	800	—	—	800	—	—	600	—	nm
Sensitivity wavelength width			200	—	1,150	350	—	1,150	400	—	750	nm
Response time	t_r,t_f	R_L = 1kΩ	—	30	—	—	30	—	—	30	—	μs

*2 Ev : Illuminance by CIE standard light source A (tungsten lamp)

Fig. 1 Photocurrent vs. Illuminance

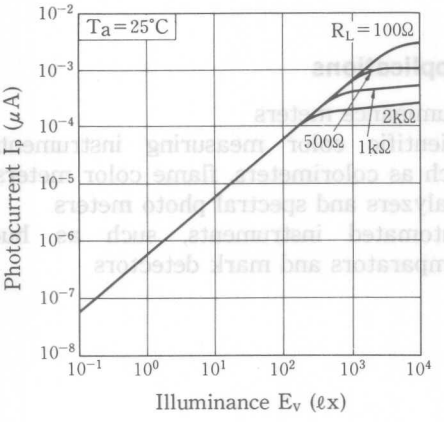


Fig. 2 Photocurrent vs. Forward Voltage

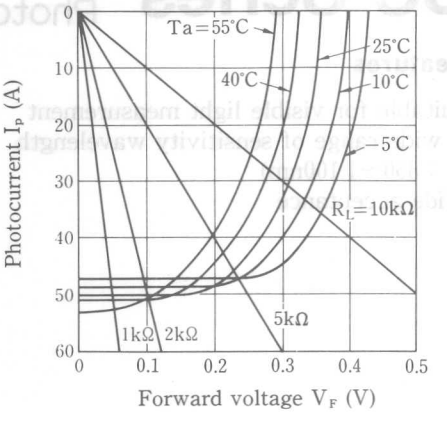


Fig. 3 Dark Current vs. Reverse Voltage

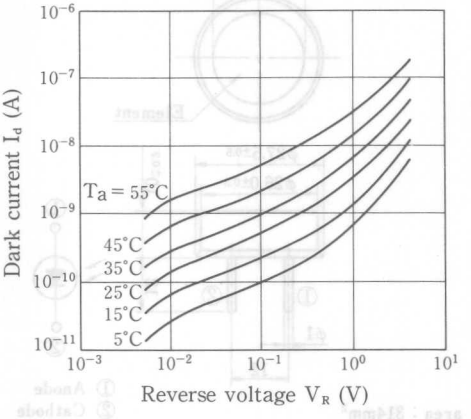


Fig. 4 Spectral Sensitivity

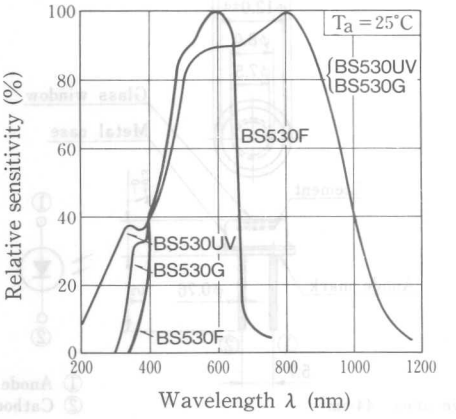
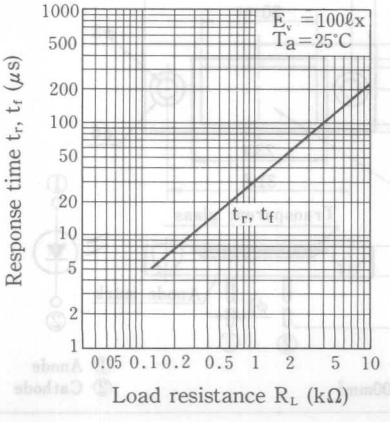
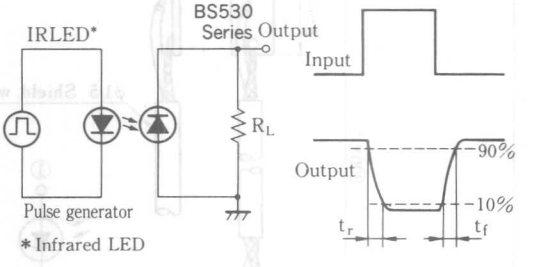


Fig. 5 Response Time vs. Load Resistance



Test Circuit for Response Time



4

SBC Series Wide Wavelength Band Type Photodiode

■ Features

1. Suitable for visible light measurement
2. A wide range of sensitivity wavelength (λ : 350~1,100nm)
3. Wide acceptance

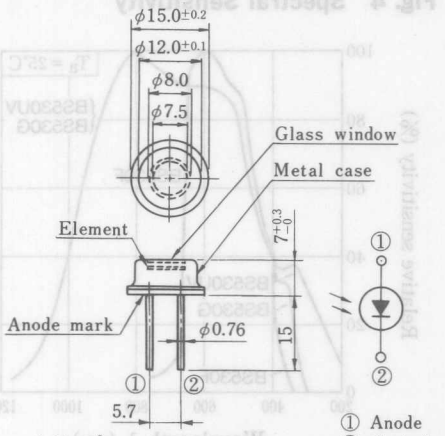
■ Applications

1. Illuminance meters
2. Scientific color measuring instruments such as colorimeters, flame color meters, analyzers and spectral photo meters
3. Automated instruments, such as hue comparators and mark detectors

■ Outline Dimensions

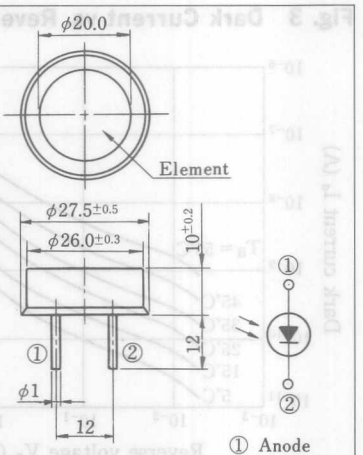
(Unit : mm)

SBC102



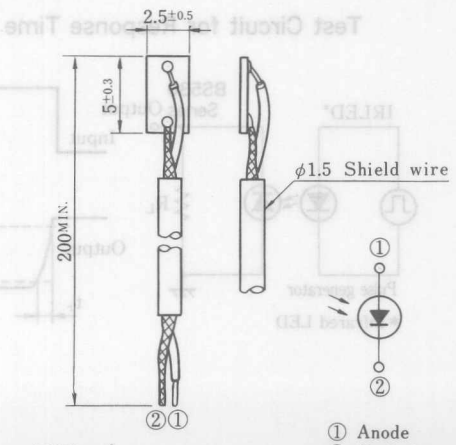
Active area : 44mm²

SBC111



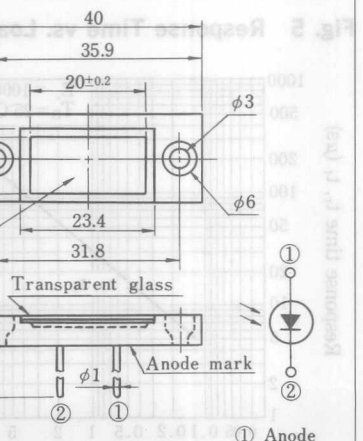
Active area : 314mm²

SBC255



Active area : 12.5mm²

SBC541



Active area : 200mm²

■ Configuration

Item	SBC102	SBC111	SBC255	SBC541	Unit
Outline	ϕ15.0	ϕ27.5	2.5×5.0	15.9×40	mm
Active area	44	314	12.5	200	mm²
Package	Metal	Acrly resin	—	Phenol resin (Black)	—

■ Absolute Maximum Ratings

Perameter	Symbol	SBC102	SBC111	SBC255	SBC541	Unit
Operating temperature	T_{opr}	−10～+70	−10～+70	−10～+70	−10～+70	°C
Storage temperature	T_{stg}	−10～+80	−10～+70	−10～+80	−10～+80	°C

■ Electro-optical Characteristics

(Ta=25°C)

Parameter	Symbol	Conditions	SBC102		SBC111		SBC255		SBC541		Unit
			MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	MIN.	TYP.	
*1Open circuit voltage	V_{OC}	E_v=100 ℓx	0.18	—	0.18	—	0.18	—	0.18	—	V
*1Short circuit current	I_{SC}	E_v=100 ℓx	15.5	—	110	—	4.4	—	70	—	μA
Response time	t_r	—	—	20	—	200	—	8	—	130	μs

*1 E_v : Illuminance by CIE standard light source A (tungsten lamp)

4

Fig. 1 Spectral Sensitivity

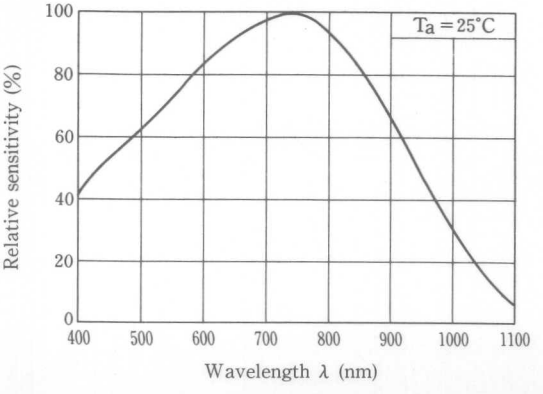


Fig. 2 Photocurrent vs. Forward Voltage (SBC102)

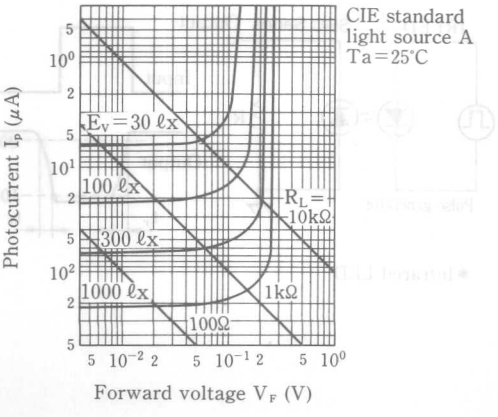


Fig. 3 Photocurrent vs. Forward Voltage (SBC255)

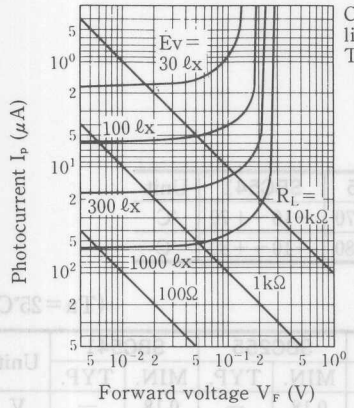


Fig. 4 Photocurrent vs. Forward Voltage (SBC541)

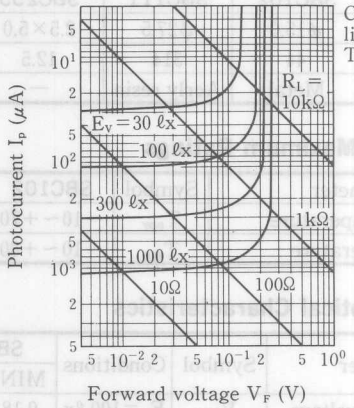


Fig. 5 Short Circuit Current, Open Circuit Voltage vs. Ambient Temperature

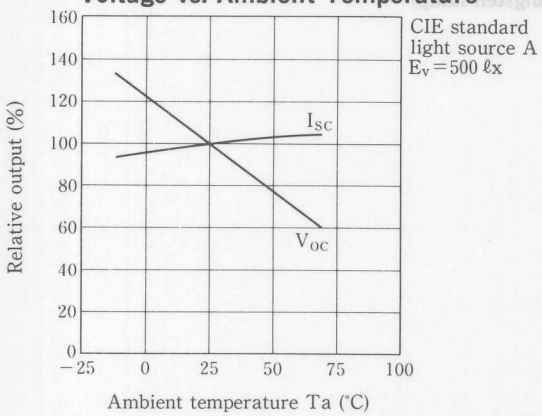
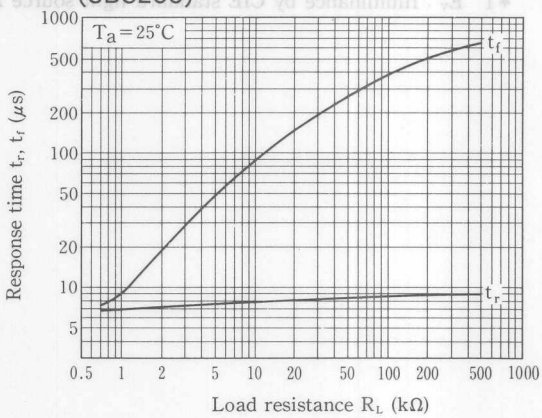
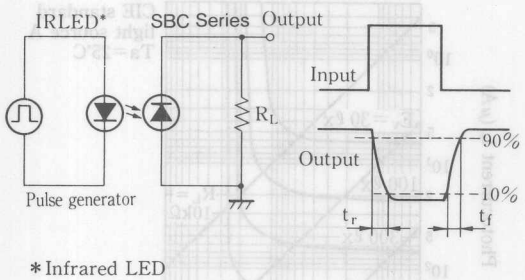


Fig. 6 Response Time vs. Load Resistance (SBC255)



Test Circuit for Response Time



*Infrared LED

PD150/PD151 TO-18 Type Color Sensor

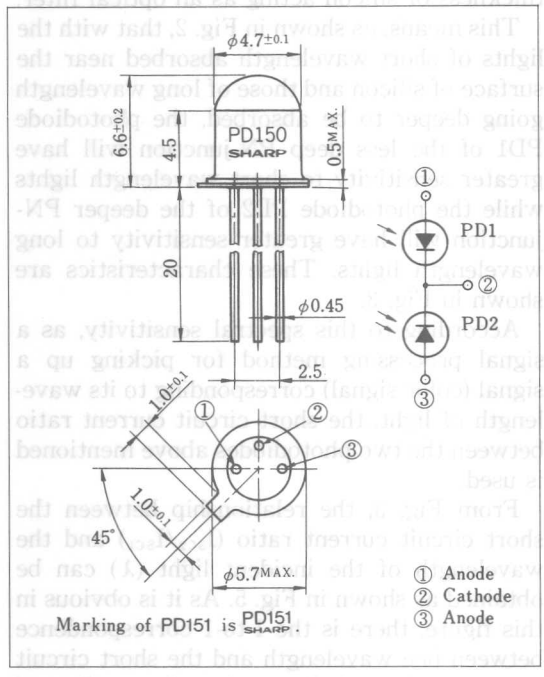
■ Features

1. Output corresponding to the wavelength of light
2. Compact 1-chip structure
3. Blue to near infrared light range
4. Infrared cut-off type : PD151

■ Applications

1. Color reading
   - Automatic white balancing for VCR cameras
   - Flame color meter for fan heaters
   - Color identification for color paper
   - Chromatic balance adjustment for TVs
2. Color temperature/wavelength reading
   - Measurement and control for color temperature/wavelength of light source

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	5	V
Operating temperature	T_{opr}	0~+70	°C
Storage temperature	T_{stg}	−25~+100	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 10 seconds at the position of 1.3mm from the bottom face of can package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Dark current		I_d	V_R=1V	—	—	10	nA
Terminal capacitance		C_{t1}	V_R=0. f=1MHz	—	200	—	pF
		C_{t2}	V_R=0, f=1MHz	—	100	—	pF
Short-circuit current	PD150	I_{SC1}	λ=600nm	—	0.75	—	μA
	PD151		E_e=50μW/cm²	—	0.65	—	μA
	PD150	I_{SC2}	λ=600nm	—	0.19	—	μA
	PD151		E_e=50μW/cm²	—	0.16	—	μA
Short-circuit current ratio		I_{SC2}/I_{SC1}	λ=600nm	—	0.25	—	—
			λ=900nm	—	4.5	—	—

■ Theory of Operation

The semiconductor color sensor PD150 is an element of two PN-junctions (photodiode) vertically incorporated into one chip with its thickness of silicon acting as an optical filter.

This means, as shown in Fig. 2, that with the lights of short wavelength absorbed near the surface of silicon and those of long wavelength going deeper to be absorbed, the photodiode PD1 of the less deep PN-junction will have greater sensitivity to short wavelength lights while the photodiode PD2 of the deeper PN-junction will have greater sensitivity to long wavelength lights. These characteristics are shown in Fig. 3.

According to this spectral sensitivity, as a signal processing method for picking up a signal (color signal) corresponding to its wavelength of light, the short circuit current ratio between the two photodiodes above mentioned is used.

From Fig. 3, the relationship between the short circuit current ratio (I_{SC2}/I_{SC1}) and the wavelength of the incident light (λ) can be obtained as shown in Fig. 5. As it is obvious in this figure, there is the 1-to-1 correspondence between one wavelength and the short circuit current ratio to indicate that the reading of color of light (wavelength) is possible.

Thus, the wavelength of blue to near infrared color can be read by PD150,

Also taken into account to make the color signal reading capability as close to that of human eye as possible is the fact the human eye is insensitive to wavelength of over 700nm. Hence the PD151 which is a PD150 with built-in infrared cut-off filter. Its spectral sensitivity characteristics are shown in Fig. 4.

Next, concretely described in Fig. 3, Fig. 4 and Fig. 5 will be a case with a monochromatic light striking upon the semiconductor color sensor and a case with a composite light of various wavelength striking upon it.

Fig. 1 Structure of Semiconductor Color Sensor

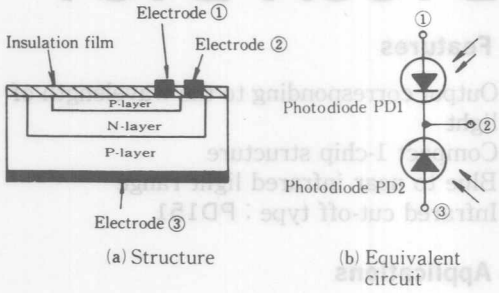


Fig. 2 Wavelength and Light Absorbtion Areas

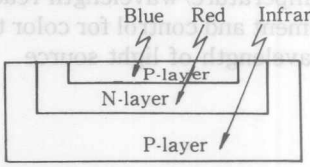
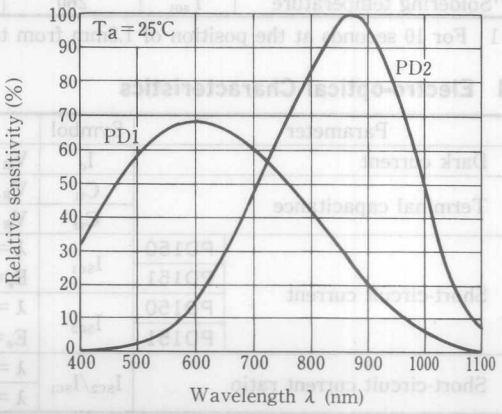


Fig. 3 Spectral Sensitivity (PD150)



(1) When a monochromatic light of wavelength (λ = 500nm) strikes upon it :

In the case with the **PD150**, the short circuit current ratio of PD1 to PD2 to be obtained from Fig. 3 :

$I_{SC2}/I_{SC1} = 0.020C_1/0.580C_1 = 0.034$

(C_1 : constant)

corresponds to the short circuit current ratio shown in Fig. 5.

The similar result can be obtained with **PD151** from Fig. 4 and Fig. 5 . However, in the case of near infrared light striking upon it even though it is monochromatic as in the above case, the **PD150** with no infrared light cut-off filter incorporated is more effective than the **PD151** because of its greater sensitivity in the near infrared zone.

(2) When a composite light of various wavelengths (visible and near infrared) strikes upon it :

Suppose the incident light is made up of a light (A) : wavelength $\lambda_A = 500$nm, irradiance $E_{eA} = 5.0$mW/cm²

and

a light (B) : wavelength $\lambda_B = 800$nm, irradiance $E_{eB} = 3.0$mW/cm²

The human eye will recognize this inciedent light as of about 500nm wavelength while this semiconductor color sensor will recognize the same light as follows.

i) With the **PD151** :

The short circuit current for PD1 and PD2, from Fig. 4, is

$I_{SC1} = (5 \times 0.900 + 3 \times 0.010)C_2 = 4.530C_2$

(C_2 : constant) ·····①

$I_{SC2} = (5 \times 0.031 + 3 \times 0.020)C_2 = 0.215C_2$

(C_2 : constant) ·····②

From the equations ① and ②, the short circuit current ratio can be obtained. Thus,

$I_{SC2}/I_{SC1} = 0.047$.

So the wavelength that corresponds to the short circuit ratio of 0.047, according to Fig. 5, is $\lambda = 510$nm, which the **PD151** recognizes.

ii) With the **PD150** :

In the same way as in i), from Fig. 3 and Fig. 5, $\lambda = 680$nm will be obtained. So the wavelength whci the **PD150** recognizes is $\lambda = 680$nm.

Fig. 4 Spectral Sensitivity (PD151)

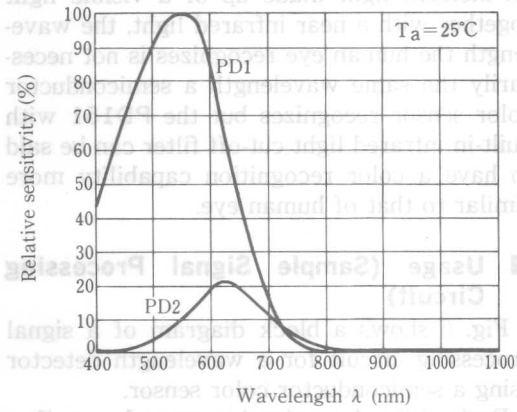


Fig. 5 Short Circuit Current Ratio vs. Wavelength (PD150, PD151)

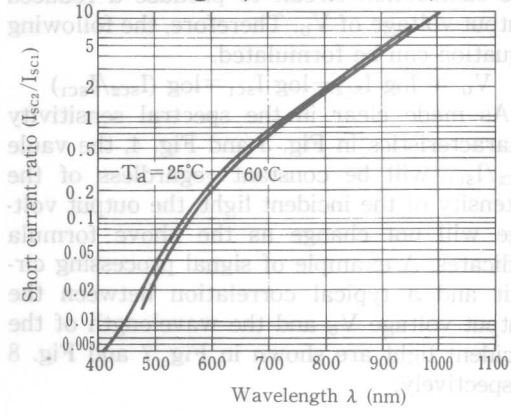
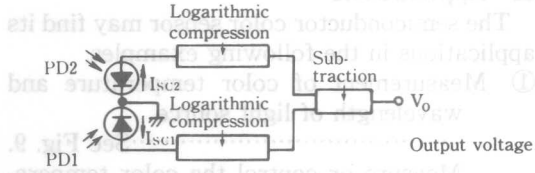


Fig. 6 Block Diagram of a Sample Signal Processing Circuit



4

As made clear by the above examples, with an incident light made up of a visible light together with a near infrared light, the wavelength the human eye recognizes is not necessarily the same wavelength a semiconductor color sensor recognizes but the **PD151** with built-in infrared light cut-off filter can be said to have a color recognition capability more similar to that of human eye.

■ Usage (Sample Signal Processing Circuit)

Fig. 6 shows a block diagram of a signal processing circuit for a wavelength detector using a semiconductor color sensor.

Each of the short circuit current I_{SC1} andI_{SC2} to be obtained from the two photodiodes is to be logarithmically compressed and go through the subtraction circuit to produce a reduced output voltage of V_O. Therefore, the following equation can be formulated.

$$V_O \propto \log I_{SC2} - \log I_{SC1} = \log (I_{SC2}/I_{SC1})$$

As made clear in the spectral sensitivity characteristics in Fig. 3 and Fig. 4, the vaule I_{SC2}/I_{SC1} will be constant regardless of the intensity of the incident light, the output voltage will not change as the above formula indicates. A example of signal processing circuit and a typical correlation between the output voltage V_O and the wavelength of the incident light are shown in Fig. 7 and Fig. 8 respectively.

■ Applications

The semiconductor color sensor may find its applications in the following examples.

① Measurement of color temperature and wavelength of light source
·····See Fig. 9.

Measure or control the color temperature or the wavelength of the light source, the light from which is made to strike directly upon the semiconductor color sensor.

Fig. 7 Example of Signal Processing Circuit

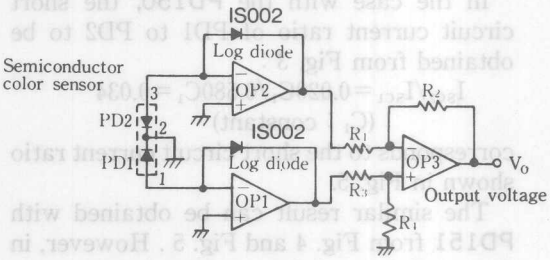


Fig. 8 Output Voltage vs. Wavelength (Typical)

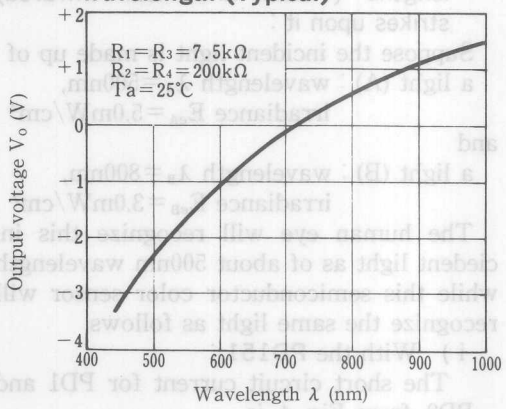
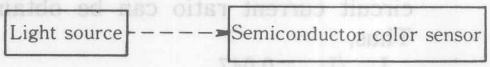


Fig. 9 Measurement of Color Temperature and Wavelength of Light Source



② Color measurement of an object (transmissive type) ·····See Fig. 10.
Measure the color of the object through which the light transmits to strike upon the semiconductor color sensor.

③ Color measurement of an object (Reflective type) ·····See Fig. 11.
Measure the color of the object which reflects the light to have it strike upon the semiconductor color sensor.

Fig. 10 Transmissive Type (Color Measurement of an Object)

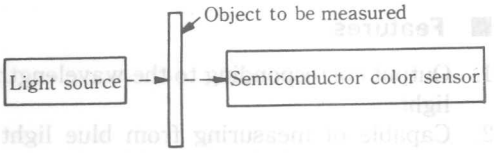
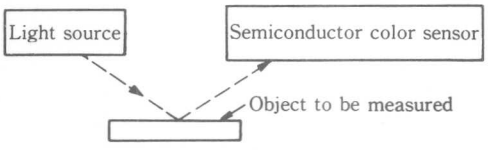


Fig. 11 Reflective Type (Color Measurement of an Object)



4

PD152 Resin Mold Type Color Sensor

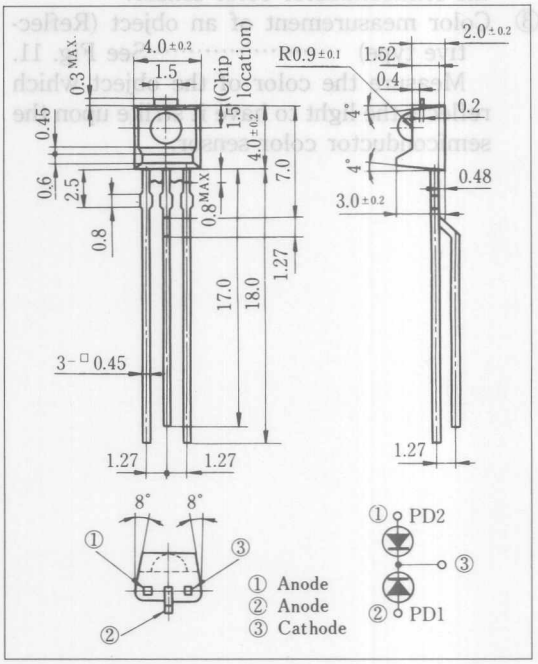
■ Features

1. Output corresponding to the wavelength of light
2. Capable of measuring from blue light to near infrared light (λ =1,000nm)
3. Compact resin package
4. General-purpose type

■ Applications

1. Automatic white balancing for VCR camera
2. Read out of color temperature and wavelength
3. Detection of object's color

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	5.0	V
Operating temperature	T_{opr}	−25～+80	°C
Storage temperature	T_{stg}	−40～+80	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 3 seconds at the position of 2.5mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Applied
Reverse voltage	I_d	V_R=1V	—	0.05	10	nA	PD1, PD2
Dark current	C_{t1}	V_R=0, f=1MHz	—	300	600	pF	PD1
Terminal capacitance	C_{t2}	V_R=0, f=1MHz	—	100	200	pF	PD2
*2Short circuit current	I_{SC1}	*3E_V=1.0mW/cm²	—	1.3	—	μA	PD1
	I_{RC2}		—	2.5	—	μA	PD2
Short circuit current ratio	I_{SC2}/I_{SC1}	λ=600nm	0.14	0.25	0.39	—	PD1
		λ=900nm	2.8	4.5	8.4	—	PD2

*2 Values for 1 element. Measured with short circuit between the anode and the cathode of non-measurement elements.

*3 E_V : Illuminance by CIE standard light source A (tungsten lamp)

■ Theory of Operation

The semiconductor color sensor PD152 is an element of two PN-junctions (photodiodes) vertically incorporated into a substrate with its thickness of silicon acting as an optical filter.

This means, as shown in Fig. 2, that with the lights of short wavelength absorbed near the surface of silicon and those of long wavelength going deeper to be absorbed, the photodiode PD1 of the less deep PN-junction will have greater sensitivity to short wavelength lights while the photodiode PD2 of the deeper PN-junction will have greater sensitivity to long wavelength lights. These characteristics are shown in Fig. 3.

According to this spectral sensitivity, as a signal processing method for picking up a signal (color signal) corresponding to its wavelength of light, the short circuit current ratio between the two photodiodes above mentioned is used.

From Fig. 3, the relationship between the short circuit current ratio (I_{SC2}/I_{SC1}) and the wavelength of the incident light (λ) can be obtained as shown in Fig. 4. As it is obvious in this figure, there is the 1-to-1 correspondence between one wavelength and the short circuit current ratio to indicate that the reading of color of light (wavelength) is possible.

Thus, the wavelength of blue to near infrared color can be read by PD152.

Also taken into account to make the color signal reading capability as close to that of human eye as possible is the fact the human eye is insensitive to wavelength of over 700nm.

Next, concretely described in Fig. 3 and Fig. 4 will be a case with a monochromatic light striking upon the semiconductor color sensor and a case with a composite light of various wavelengths striking upon it.

(1) When a monochromatic light of wavelength (λ = 500nm) strikes upon it :

The short circuit current ratio of PD1 and PD2 are obtained from Fig. 3 :

$$I_{SC2}/I_{SC1} = 0.020C_1/0.540C_1 = 0.037$$

(C_1 : constant)

corresponds to the short circuit current ratio shown in Fig. 4.

Fig. 1 Structure of Semiconductor Color Sensor

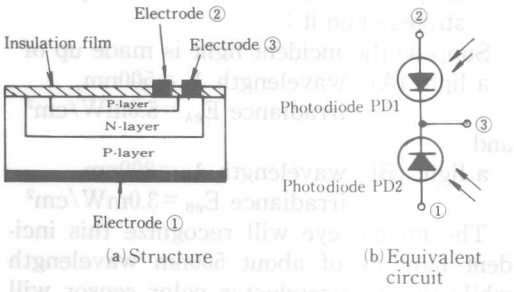


Fig. 2 Wavelength and Light Absorbtion Areas

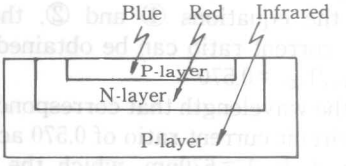
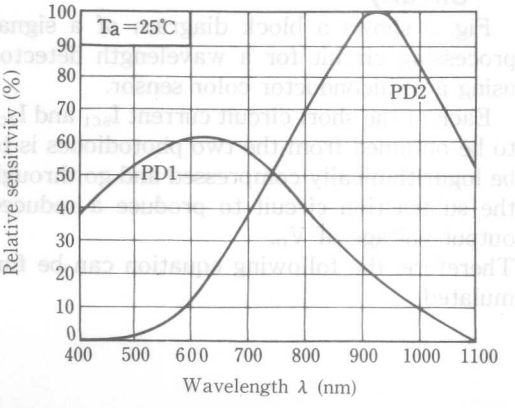


Fig. 3 Spectral Sensitivity



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(2) When a composite light of various wavelengths (visible and near infrared) strikes upon it :

Suppose the incident light is made up of a light (A) : wavelength $\lambda_A = 500$nm, irradiance $E_{eA} = 5.0$mW/cm^2

and

a light (B) : wavelength $\lambda_B = 800$nm, irradiance $E_{eB} = 3.0$mW/cm^2

The human eye will recognize this incident light as of about 500nm wavelength while this semiconductor color sensor will recognize the same light as follows.

The short circuit current for PD1 and PD2, from Fig. 3, is

$I_{SC1} = 5 \times 0.540 + 3 \times 0.405)\ C_2 = 3.915C_2$
(C_2 : constant) ·····①

$I_{SC2} = (5 \times 0.020 + 3 \times 0.710)\ C_2 = 2.230C_2$
(C_2 : constant) ·····②

From the equations ① and ②, the short circuit current ratio can be obtained. Thus,

$I_{SC2}/I_{SC1} = 0.570$

So, the wavelength that corresponds to the short circuit current ratio of 0.570 according to Fig. 4, is $\lambda = 670$nm, which the PD152 recognizes.

As made clear by the above examples, with an incident light made up of a visible light together with a near infrared light, the wavelength the human eye recognizes is not neccessarily the same wavelength a semiconductor color sensor recognizes.

■ Usage (Sample Signal Processing Circuit)

Fig. 5 shows a block diagram of a signal processing circuit for a wavelength detector using a semiconductor color sensor.

Each of the short circuit current I_{SC1} and I_{SC2} to be obtained from the two photodiodes is to be logarithmically compressed and go through the subtraction circuit to produce a reduced output voltage of V_O.

Therefore, the following equation can be formulated.

Fig. 4 Short Circuit Current Ratio vs. Wavelength

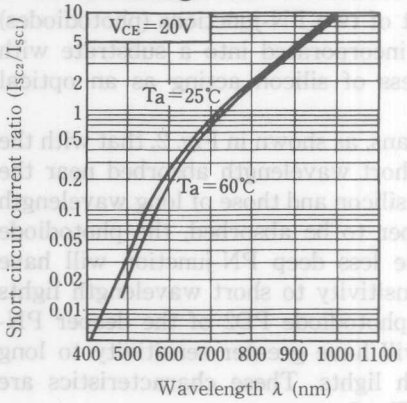


Fig. 5 Block Diagram of a Sample Signal Processing Circuit

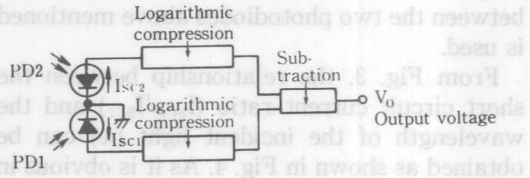
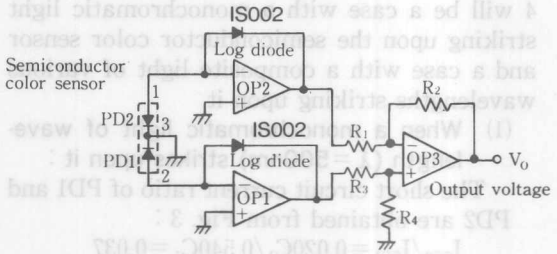


Fig. 6 Example of Signal Processing Circuit



$V_o \propto \log I_{SC2} - \log I_{SC1} = \log (I_{SC2}/I_{SC1})$

As made clear in the spectral sensitivity characteristics in Fig. 3, the value I_{SC2}/I_{SC1} will be constant regardless of the intensity of the incident light, the output voltage will not change as the above formula indicates. A example of signal processing circuit and a typical correlation between the output voltage V_o and the wavelength of the incident light are shown in Fig. 6 and Fig. 7 respectively.

■ Applications

The semiconductor color sensor may find its applications in the following examples.

① Measurement of color temperature and wavelength of light source
·····See Fig. 8.
Measure or control the color temperature or the wavelength of the light source, the light from which is made to strike directly upon the semiconductor color sensor.

② Color measurement of an object (transmissive type) ·····See Fig. 9.
Measure the color of the object through which the light transmits to strike upon the semiconductor color sensor.

③ Color measurement of an object (reflective type) ·····See Fig. 10.
Measure the color of the object which reflects the light to have it strike upon the semiconductor color sensor.

Fig. 7 Output Voltage vs. Wavelength (Typical)

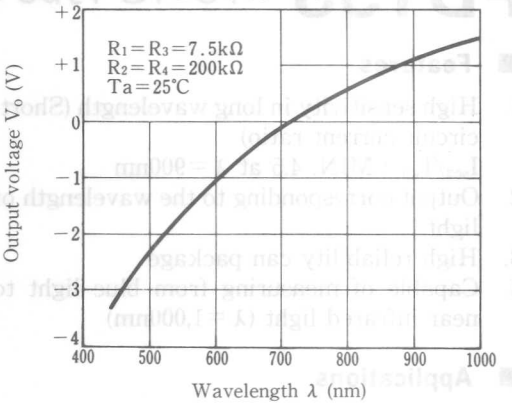


Fig. 8 Measurement of Color Temperature and Wavelength of Light Source



Fig. 9 Transmissive Type (Color Measurement of an Object)

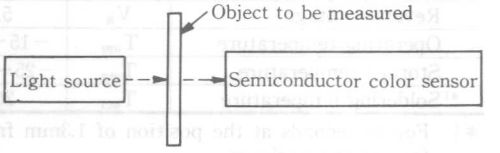
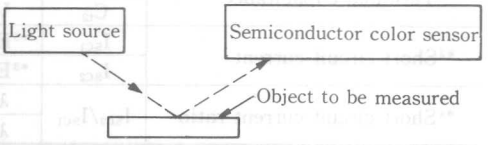


Fig. 10 Reflective Type (Color Measurement of an Object)



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PD153 TO-18 Type Color Sensor

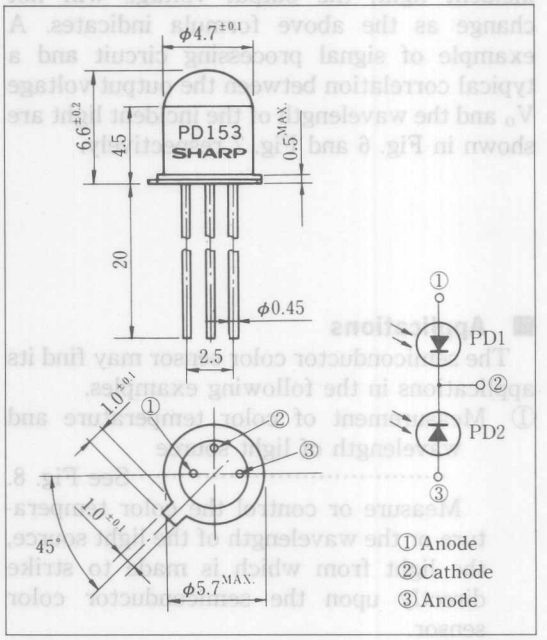
■ Features

1. High sensitivity in long wavelength (Short-circuit current ratio)
   I_{sc2}/I_{sc1} : MIN. 4.5 at λ = 900nm
2. Output corresponding to the wavelength of light
3. High reliability can package
4. Capable of measuring from blue light to near infrared light (λ = 1,000nm)

■ Applications

1. Read out of paper currency's color in money exchanger
2. Read out of color temperature and wavelength
3. Detection of object's color

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Rating	Unit
Reverse voltage	V_R	5.0	V
Operating temperature	T_{opr}	−15 ~ +70	°C
Storage temperature	T_{stg}	−25 ~ +100	°C
*1 Soldering temperature	T_{sol}	260	°C

*1 For 10 seconds at the position of 1.3mm from the bottom face of can package.

■ Electro-optical Characteristics (Ta = 25°C)

Parameter	Symbol	Conditions	Applied	MIN.	TYP.	MAX.	Unit
Reverse voltage	V_R	I_R = 1μA	PD1, PD2	5.0	—	—	V
Dark current	I_d	V_R = 1V	PD1, PD2	—	0.05	5	nA
Terminal capacitance	C_{t1}	V_R = 0, f = 1MHz	PD1	—	300	600	pF
	C_{t2}	V_R = 0, f = 1MHz	PD2	—	100	200	pF
*2 Short circuit current	I_{SC1}	*3 Ee = 1.0mW/cm²	PD1	—	4.5	—	μA
	I_{SC2}	*3 Ee = 1.0mW/cm²	PD2	—	10.0	—	μA
*4 Short circuit current ratio	I_{SC2}/I_{SC1}	λ = 600nm	PD1, PD2	0.14	0.24	0.39	—
		λ = 900nm	PD1, PD2	4.5	5.10	8.4	—

*2 Values for 1 element. Measured with short circuit between the anode and the cathode of non-measurement elements.
*3 Ee : Illuminance by CIE standard light source A (tungsten lamp)
*4 Short circuit current ratio (I_{SC2}/I_{SC1}) shall be measured under that both short circuit currents I_{SC1}, I_{SC2} are 0.05 ~ 10μA.

■ Theory of Operation

The semiconductor color sensor PD153 is an element of two PN-junctions (photodiodes) vertically incorporated into a substrate with its thickness of silicon acting as an optical filter.

This means, as shown in Fig. 2, that with the lights of short wavelength absorbed near the surface of silicon and those of long wavelength going deeper to be absorbed, the photodiode PD1 of the less deep PN-junction will have greater sensitivity to short wavelength lights while the photodiode PD2 of the deeper PN-junction will have greater sensitivity to long wavelength lights. These characteristics are shown in Fig. 3.

According to this spectral sensitivity, as a signal processing method for picking up a signal (color signal) corresponding to its wavelength of light, the short circuit current ratio between the two photodiodes above mentioned is used.

From Fig. 3, the relationship between the short circuit current ratio (I_{SC2}/I_{SC1}) and the wavelength of the incident light (λ) can be obtained as shown in Fig. 4. As it is obvious in this figure, there is the 1-to-1 correspondence between one wavelength and the short circuit current ratio in indicate that the reading of color of light (wavelength) is possible.

Thus, the wavelengths of blue to near infrared color can be read by PD153.

Also taken into account to make the color signal reading capability as close to that of human eye as possible is the fact the human eye is insensitive to wavelength of over 700nm.

Next, concretely described in Fig. 3 and Fig. 4 will be a case with a monochromatic light striking upon the semiconductor color sensor and a case with a composite light of various wavelengths striking upon it.

(1) When a monochromatic light of wavelength (λ = 500nm) strikes upon it :

The short circuit current ratio of PD1 and PD2 are obtained from Fig. 3 :

$I_{SC2}/I_{SC1} = 0.035C_1/10.595C_1 = 0.059$ (C_1 : constant)

corresponds to the short circuit current ratio shown in Fig. 4.

Fig. 1 Structure of Semicunductor Color Sensor

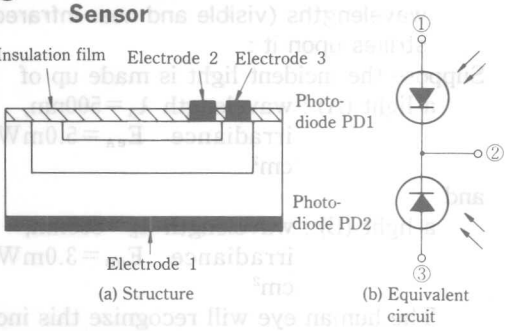


Fig. 2 Wavelength and Light Absorbtion Areas

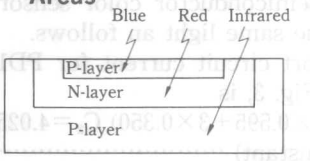


Fig. 3 Spectral Sensitivity

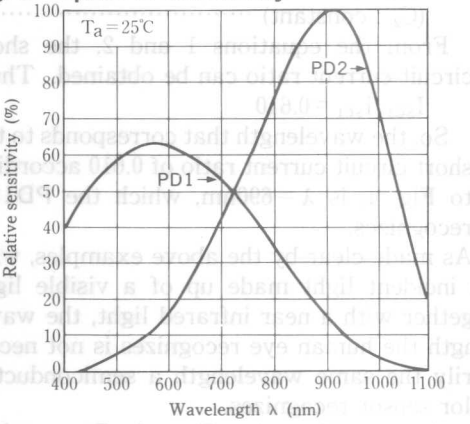
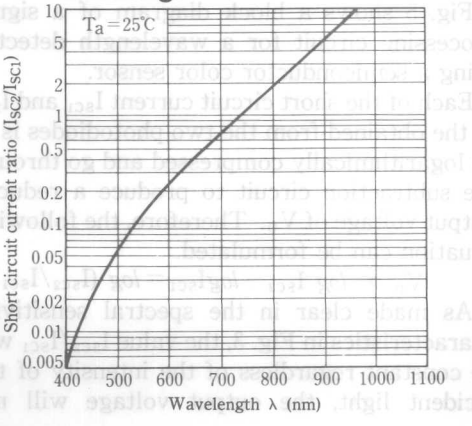


Fig. 4 Short Circuit Current Ratio vs. Wavelength



4

(2) When a composite light of various wavelengths (visible and near infrared) strikes upon it :

Suppose the incident light is made up of

a light (A) : wavelength $\lambda_A = 500$nm, irradiance $E_{eA} = 5.0$mW/cm^2

and

a light (B) : wavelength $\lambda_B = 800$nm, irradiance $E_{eB} = 3.0$mW/cm^2

The human eye will recognize this incident light as of about 500nm wavelength while this semiconductor color sensor will recognize the same light an follows.

The short circuit current for PD1 and PD2, from Fig. 3, is

$I_{SC1} = (5 \times 0.595 + 3 \times 0.350)\ C_2 = 4.025$

(C_2 : constant) ·····1

$I_{SC2} = (5 \times 0.035 + 3 \times 0.760)\ C_2 = 2.455C_2$

(C_2 : constant) ·····2

From the equations 1 and 2, the short circuit current ratio can be obtained. Thus,

$I_{SC2}/I_{SC1} = 0.610$

So, the wavelength that corresponds to the short circuit current ratio of 0.610 according to Fig. 4, is $\lambda = 690$nm, which the PD153 recognizes.

As made clear by the above examples, with an incident light made up of a visible light together with a near infrared light, the wavelength the human eye recognizes is not necessarily the same wavelength a semiconductor color sensor recognizes.

■ Usage (Sample Signal Processing Circuit)

Fig. 5 shows a block diagram of a signal processing circuit for a wavelength detector using a semiconductor color sensor.

Each of the short circuit current I_{SC1} and I_{SC2} to the obtained from the two photodiodes is to be logarithmically compressed and go through the subtraction circuit to produce a reduced output voltage of V_O. Therefore, the following equation can be formulated.

$$V_O \propto log\ I_{SC2} - log I_{SC1} = log\ (I_{SC2}/I_{SC1})$$

As made clear in the spectral sensitivity characteristics in Fig. 3, the value I_{SC2}/I_{SC1} will be constant regardless of the intensity of the incident light, the output voltage will not

Fig. 5 Block Diagram of a Sample Signal Processing Circuit

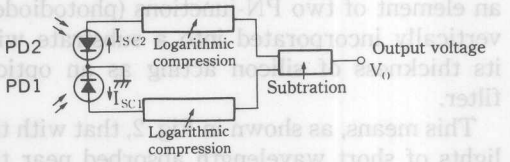


Fig. 6 Example of Signal Processing Circuit

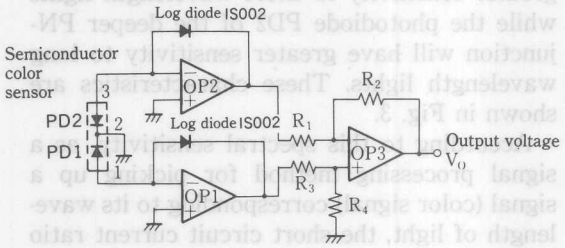


Fig. 7 Output voltage vs. Wavelength (Typical)

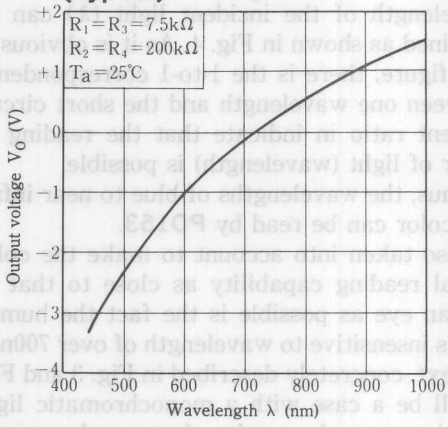
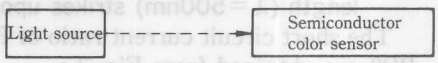


Fig. 8 Measurement of Color Temperature and Wavelength of Light Source



change as the above formula indicates.

A example of signal processing circuit and a typical correlation between the output voltage V_O and the wavelength of the incident light are shown in Fig. 6 and Fig. 7 respectively.

■ Applications

The semiconductor color sensor may find its applications in the following examples.

①Measurement of color temperature and wavelength of light source·····See Fig. 8.
Measure or control the color temperature or the wavelength of the light source, the light from which is made to strike directly upon the semiconductor color sensor.

②Color measurement of an object (transmissive type)·····See Fig. 9.
Measure the color of the object through which the light transmits to strike upon the semiconductor color sensor.

③Color measurement of an object (reflective type) ·····See Fig. 10.
Measure the color of the object which reflects the light to have it strike upon the semiconductor color sensor.

Fig. 9 Transmissive Type (Color Measurement of an Object)

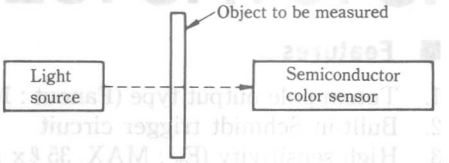
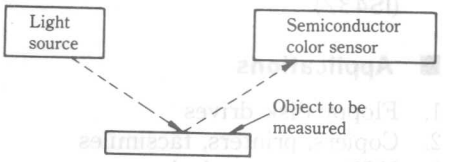


Fig. 10 Reflective Type (Color Measurement of an Object)



4

IS431/IS432 Totem Pole Output Type OPIC Light Detector

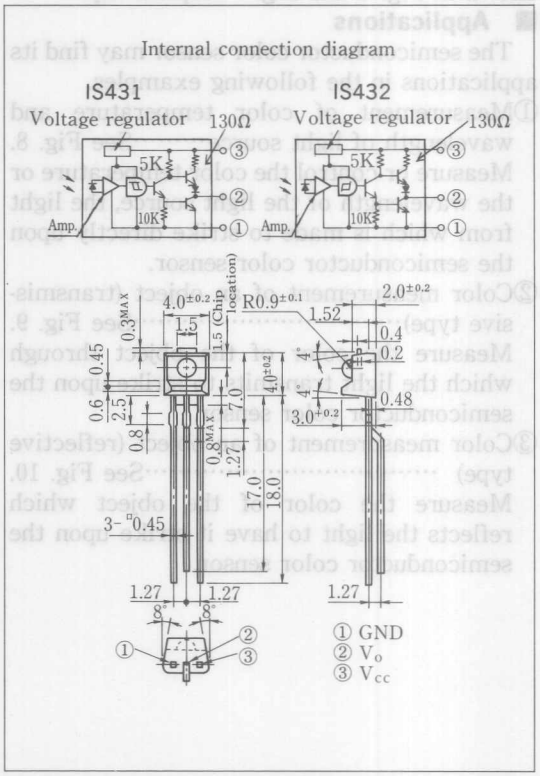
■ Features

1. Totem pole output type (Fanout : 10 gates)
2. Built-in Schmidt trigger circuit
3. High sensitivity (E_V : MAX. 35 ℓx at Ta= 25°C)
4. Low level output under incident light (IS431)
   High level output under incident light (IS432)

■ Applications

1. Floppy disk drives
2. Copiers, printers, facsimiles
3. VCRs, cassette decks
4. Automatic vending machines

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	−0.5～+7	V
Power dissipation	P	250	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+100	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 2.5mm from the bottom face of package.

■ Electro-optical Characteristics

(Unless otherwise specified Ta=0~70°C, V_{CC}=5V)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Low level output voltage			V_{OL}	V_{CC}=4.5V, I_{OL}=16mA*2	—	0.15	0.4	V
High level output voltage			V_{OH}	V_{CC}=4.5V, I_{OH}=−400μA*3	2.4	—	—	V
Low level supply current			I_{CCL}	*2	—	2.3	5.0	mA
High level supply current			I_{CCH}	*3	—	1.3	3.5	mA
Output short circuit current			I_{OS}	T≦1 sec., *3	6	17	35	mA
*4"High"→"Low" threshold illuminance		IS431	E_{VHL}	Ta=25°C	—	15	35	ℓx
					—	—	50	
		IS432		Ta=25°C	1.5	10	—	
					1	—	—	
*5"Low"→"High" threshold illuminance		IS431	E_{VLH}	Ta=25°C	1.5	10	—	ℓx
					1	—	—	
		IS432		Ta=25°C	—	15	35	
					—	—	50	
*6Hysteresis		IS431	E_{VLH}/E_{VHL}	Ta=25°C, R_L=280Ω	0.50	0.65	0.90	—
		IS432	E_{VHL}/E_{VLH}					
Response time	"High"→"Low" propagation time	IS431	t_{PHL}	Ta=25°C, E_v=50 ℓx, R_L=280Ω	—	3	9	μs
		IS432			—	5	15	
	"Low"→"High" propagation time	IS431	t_{PLH}		—	5	15	
		IS432			—	3	9	
	Rise time		t_r		—	0.1	0.5	
	Fall time		t_f		—	0.05	0.5	

*2 Defines E_v=50 ℓx (IS431) and E_v=0 (IS432).
*3 Defines E_v=0 (IS431) and E_v=50 ℓx (IS432).
*4 E_{VHL} represents illuminance by CIE standard light source A (tungsten lamp) when output goes from high to low.
*5 E_{VLH} represents illuminance by CIE standard light source A (tungsten lamp) when output goes from low to high.
*6 Hysteresis stands for E_{VLH}/E_{VHL} (IS431) and E_{VHL}/E_{VLH} (IS432).

■ Recommended Operating Conditions (Ta=0~+70°C)

Parameter	Symbol	MIN.	MAX.	Unit
Supply voltage	V_{CC}	4.5	5.5	V
Low level output current	I_{OL}	—	16	mA
High level output current	I_{OH}	—	−400	μA

Fig. 1 Power Dissipation vs. Ambient Temperature

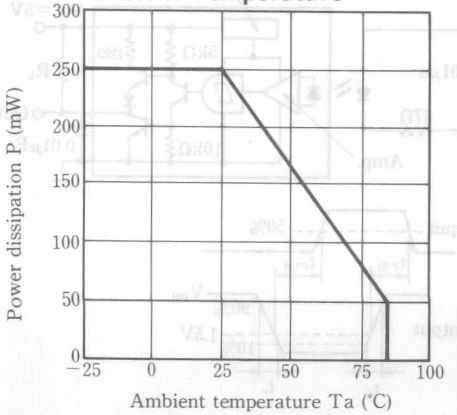
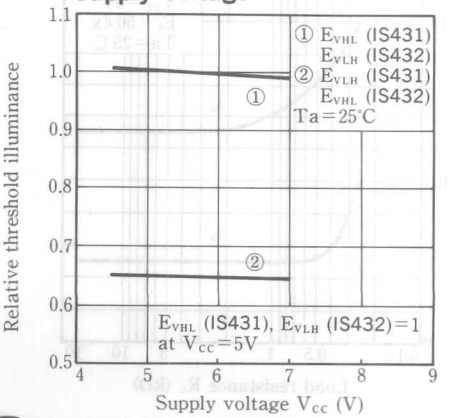


Fig. 2 Relative Threshold Illuminance vs. Supply Voltage



4

Fig. 3 Low Level Output Voltage vs. Low Level Output Current

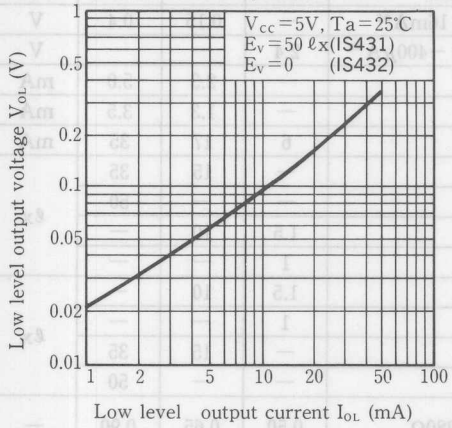


Fig. 4 Low Level Output Voltage vs. Ambient Temperature

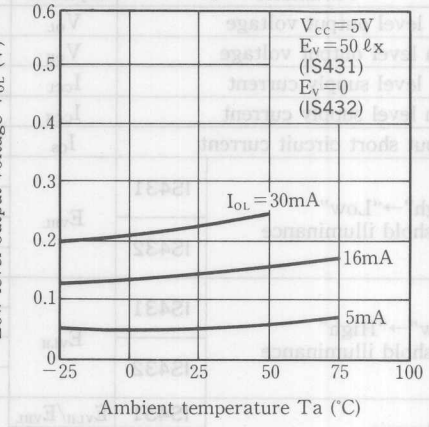


Fig. 5 Supply Current vs. Supply Voltage

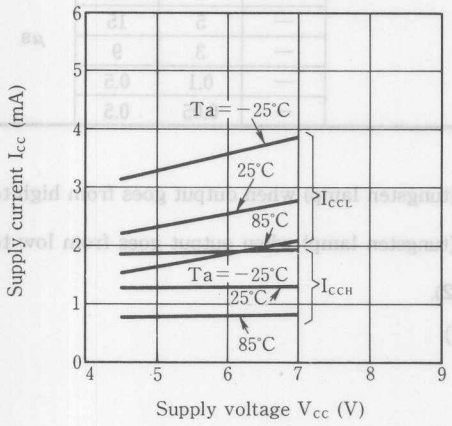


Fig. 6 Propagation Time vs. Illuminance

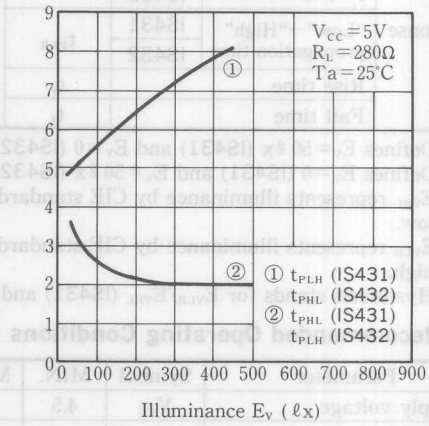
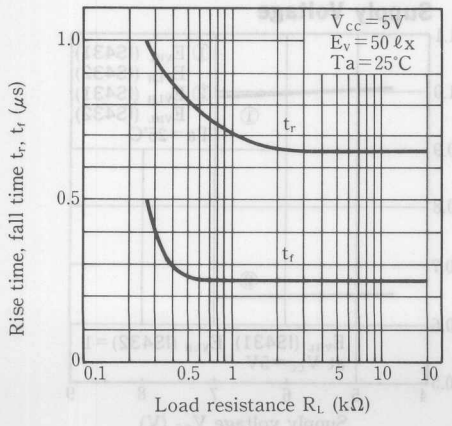
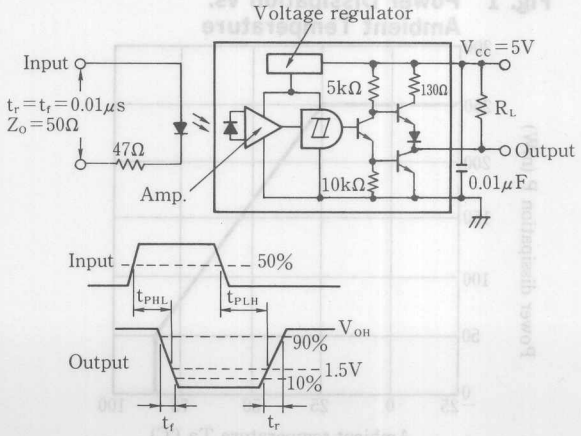


Fig. 7 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time (IS431)



Test Circuit for Response Time (IS432)

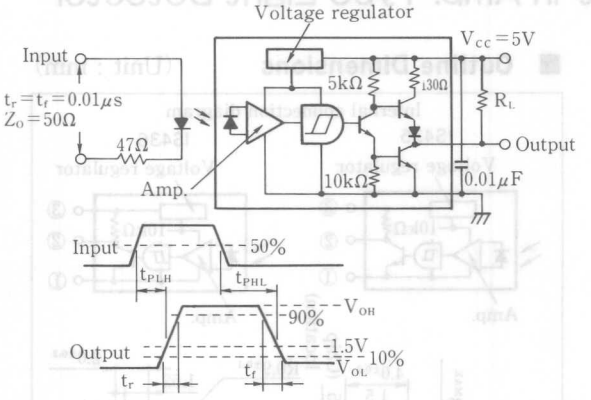
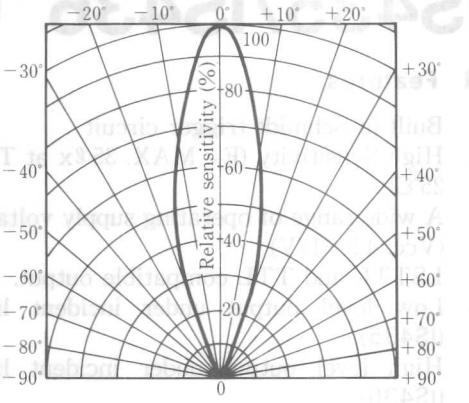


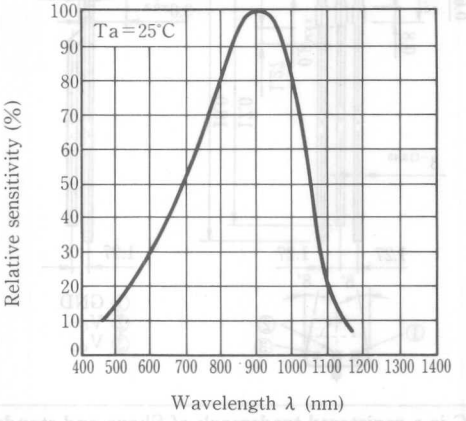
Fig. 8 Sensitivity Diagram

(Ta = 25°C)



Angular displacement θ

Fig. 9 Spectral Sensitivity



Wavelength λ (nm)

4

IS435/IS436 Built-in Amp. Type Light Detector

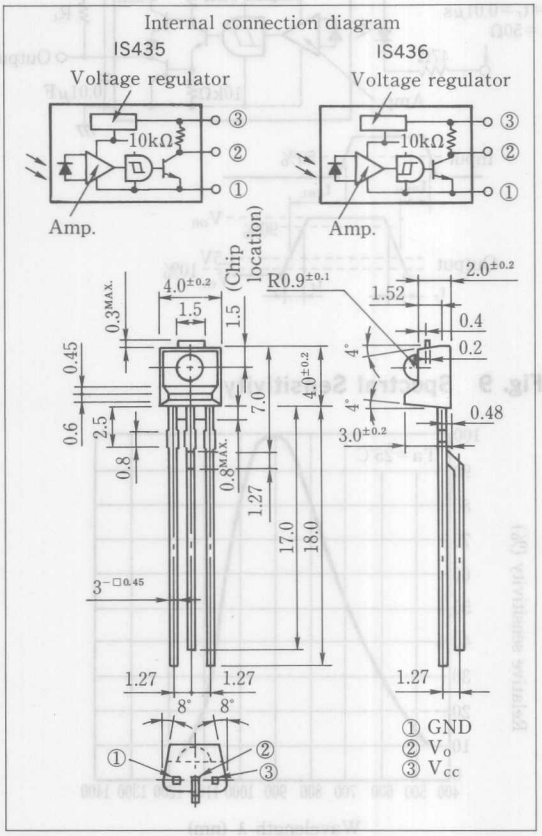
■ Features

1. Built-in Schmidt trigger circuit
2. High Sensitivity (E_V: MAX. 35 ℓx at Ta= 25°C)
3. A wide range of operating supply voltages (Vcc: 4.5～17V)
4. LSTTL and TTL compatible output.
5. Low level output under incident light (IS435)
   High level output under incident light (IS436)

■ Applications

1. Floppy disk drives
2. Copiers, printers, facsimiles
3. VCRs, cassette decks
4. Automatic vending machines

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	−0.5～+17	V
Output current	I_O	50	mA
Power dissipation	P	250	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+100	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 2.5mm from the bottom face of resin package.

■ Electro-optical Characteristics

(Unless otherwise specified, Ta=0~+70°C, Vcc=5V)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Low level output voltage		V_{OL}	I_{OL}=16mA *2	—	0.15	0.4	V
High level output voltage		V_{OH}	*3	3.5	—	—	V
Low level supply current		I_{CCL}	*2	—	2.5	5.0	mA
High level supply current		I_{CCH}	*3	—	1.0	3.0	mA
*4"High"→"Low" threshold illuminance	IS435	E_{VHL}	Ta=25°C	—	15	35	ℓx
				—	—	50	
	IS436		Ta=25°C	1.5	10	—	
				1	—	—	
*5"Low"→"High" threshold illuminance	IS435	E_{VLH}	Ta=25°C	1.5	10	—	ℓx
				1	—	—	
	IS436		Ta=25°C	—	15	35	
				—	—	50	
*6Hysteresis	IS435	E_{VLH}/E_{VHL}	Ta=25°C	0.50	0.65	0.90	—
	IS436	E_{VHL}/E_{VLH}					
Response time "High"→"Low" propagation time	IS435	t_{PHL}	Ta=25°C EV=50ℓx R_L=280Ω	—	3	9	μs
	IS436			—	5	15	
Response time "Low"→"High" propagation time	IS435	t_{PLH}		—	5	15	
	IS436			—	3	9	
Response time Rise time		t_r		—	0.1	0.5	
Response time Fall time		t_f		—	0.05	0.5	

*2 Defines Ev=50 ℓx (IS435) and Ev=0 (IS436).
*3 Defines Ev=0 (IS435) and Ev=50 ℓx (IS436).
*4 E_{VHL} represents illuminance by CIE standard light source A (tungsten lamp) when output goes from high to low.
*5 E_{VLH} represents illuminance by CIE standard light source A (tungsten lamp) when output goes from low to high.
*6 Hysteresis stands for E_{VLH}/E_{VHL} (IS435) and E_{VHL}/E_{VLH} (IS436).

■ Recommended Operating Conditions

(Ta=0~+70°C)

Parameter	Symbol	MIN.	MAX.	Unit
Supply voltage	Vcc	4.5	17	V
Output current	Io	—	16	mA

Fig. 1 Power Dissipation vs. Ambient Temperature

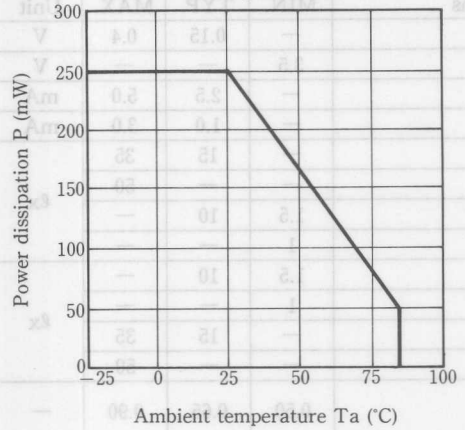


Fig. 2 Relative Threshold Illuminance vs. Supply Voltage

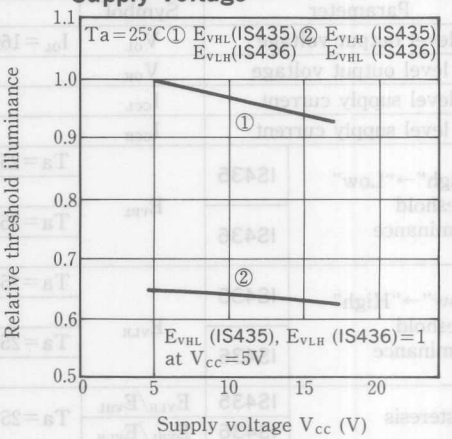


Fig. 3 Low Level Output Voltage vs. Low Level Output Current

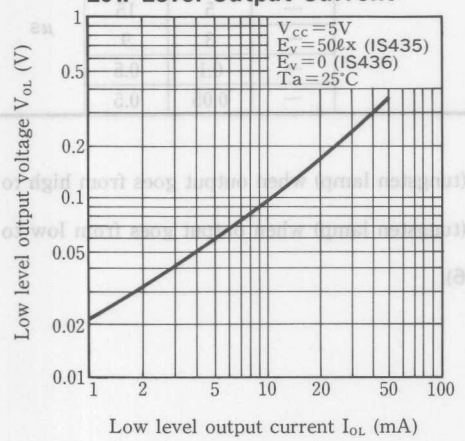


Fig. 4 Low Level Output Voltage vs. Ambient Temperature

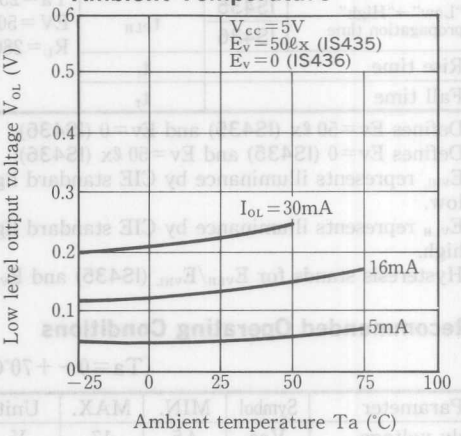


Fig. 5 Supply Current vs. Supply Voltage

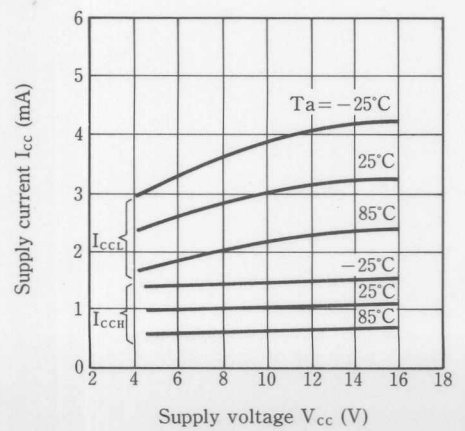


Fig. 6 Propagation Time vs. Illuminance

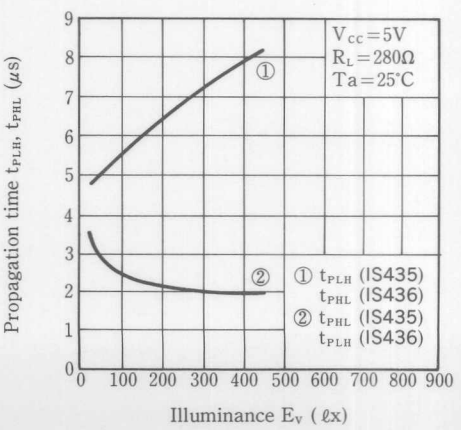
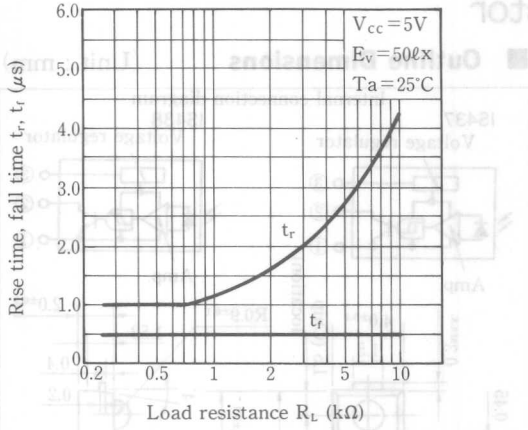
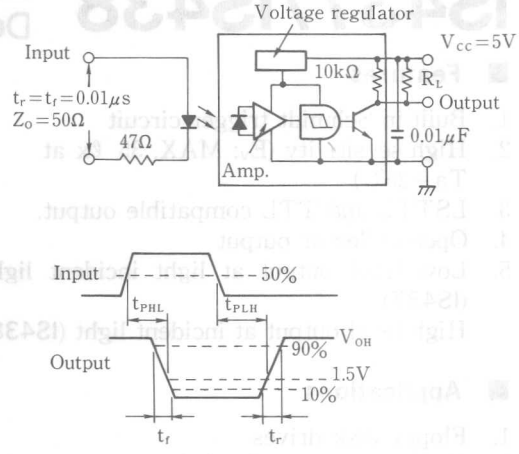


Fig. 7 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time (IS435)



Test Circuit for Response Time (IS436)

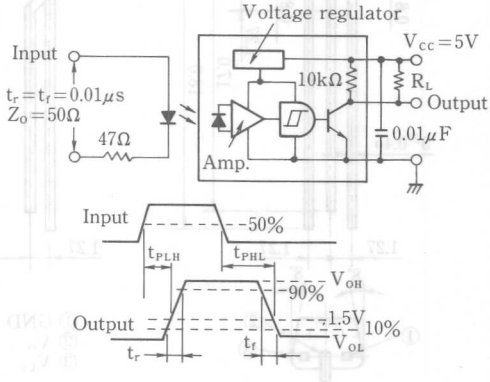


Fig. 8 Sensitivity Diagram (Ta=25°C)

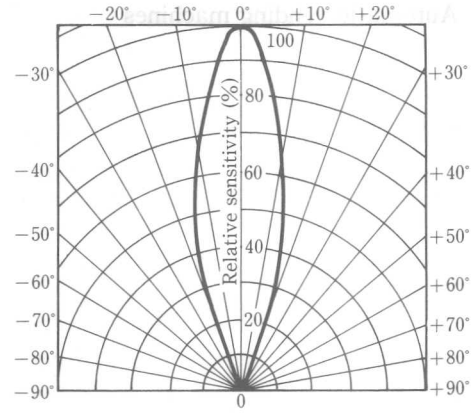
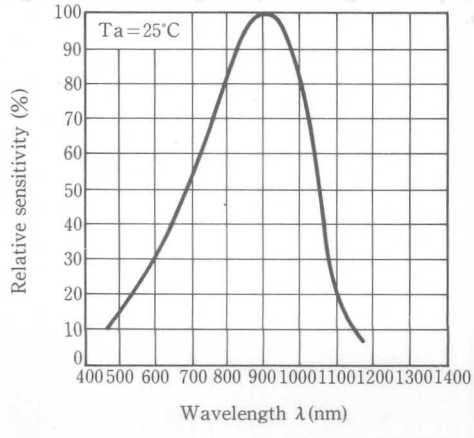


Fig. 9 Spectral Sensitivity



4

IS437/IS438 Built-in Amp. Type Opic Light Detector

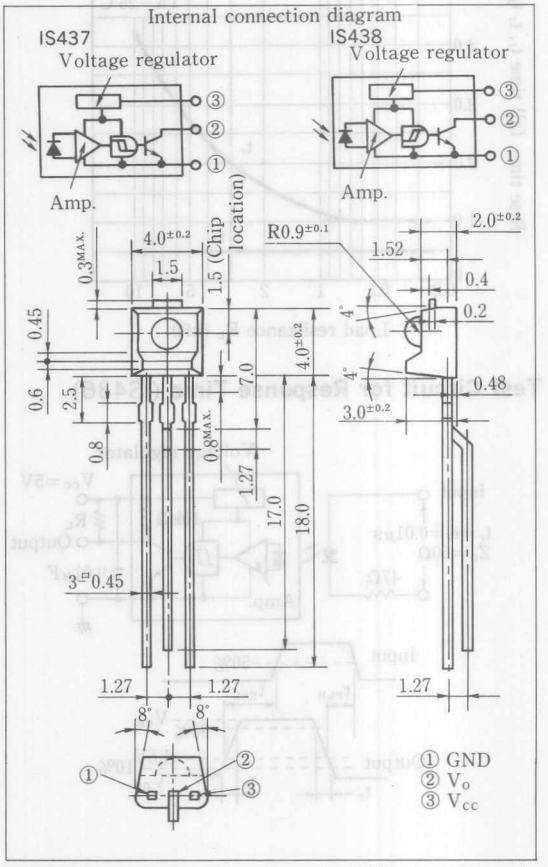
■ Features

1. Built-in Schmidt trigger circuit
2. High sensitivity (E_V: MAX. 35 ℓx at Ta=25℃)
3. LSTTL and TTL compatible output.
4. Open collector output
5. Low level output at light incident light (IS437)
   High level output at incident light (IS438)

■ Applications

1. Floppy disk drives
2. Copiers, printers, facsimiles
3. VCRs, cassette tape recorder
4. Automatic vending machines

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	−0.5～+35	V
Output voltage	V_O	−0.5～+40	V
Output current	I_O	50	mA
Power dissipation	P	250	mW
Operating temperature	T_{opr}	−25～+85	℃
Storage temperature	T_{stg}	−40～+100	℃
*1Soldering temperature	T_{sol}	260	℃

*1 For 5 seconds at the position of 2.5mm from the bottom face of resin package.

■ Electro-optical Characteristics

(Unless otherwise specified, Ta=0~70°C, V_{CC}=5V)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage			V_{CC}	Ta=25°C	4.5	—	35	V
Low level output voltage			V_{OL}	I_{OL}=16mA*2	—	0.15	0.4	V
Low level output current			I_{OH}	V_{CC}=20V, V_O=30V*3	—	—	100	μA
Low level supply current			I_{CCL}	*2	—	2.0	4.5	mA
High level supply current			I_{CCH}	*3	—	1.0	3.0	mA
*4"High"→"Low" threshold illuminance		IS437	E_{VHL}	Ta=25°C, R_L=280Ω	—	15	35	ℓx
				R_L=280Ω	—	—	50	
		IS438		Ta=25°C, R_L=280Ω	1.5	10	—	
				R_L=280Ω	1	—	—	
*5"Low"→"High" threshold illuminance		IS437	E_{VLH}	Ta=25°C, R_L=280Ω	1.5	10	—	ℓx
				R_L=280Ω	1	—	—	
		IS438		Ta=25°C, R_L=280Ω	—	15	35	
				R_L=280Ω	—	—	50	
*6Hysteresis		IS437	E_{VLH}/E_{VHL}	Ta=25°C, R_L=280Ω	0.50	0.65	0.90	—
		IS438	E_{VHL}/E_{VLH}					
Response time	"Low"→"High" propagation time	IS437	t_{PLH}	Ta=25°C, E_v=50 ℓx, R_L=280Ω	—	5	15	μs
		IS438			—	3	9	
	"High"→"Low" propagation time	IS437	t_{PHL}		—	3	9	
		IS438			—	5	15	
	Rise time		t_r		—	0.1	0.5	
	Fall time		t_f		—	0.05	0.5	

*2 Defines E_v=50 ℓx (IS437) and E_v=0 (IS438).
*3 Defines E_v=0 (IS437) and E_v=50 ℓx (IS438).
*4 E_{VHL} represents illuminance by CIE standard light source A (tungsten lamp) when output changes from high to low.
*5 E_{VLH} represents illuminance by CIE standard light source A (tungsten lamp) when output changes from low to high.
*6 Hysteresis stands for E_{VLH}/E_{VHL} (IS437) and E_{VHL}/E_{VLH} (IS438).

■ Recommended Operating Conditions

Parameter	Symbol	MIN.	MAX.	Unit
Supply voltage	V_{CC}	4.5	20	V
Output voltage	V_O	0	30	V
Output current	I_O	—	16	mA

Fig. 1 Power Dissipation vs. Ambient Temperature

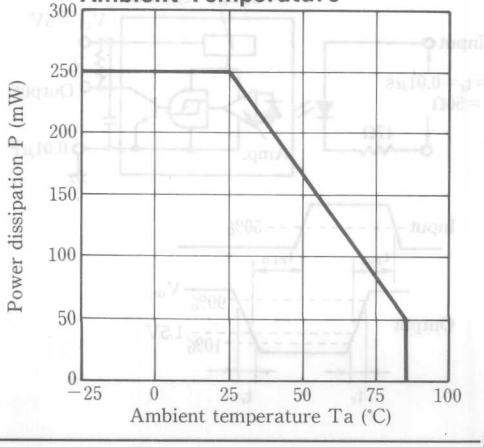
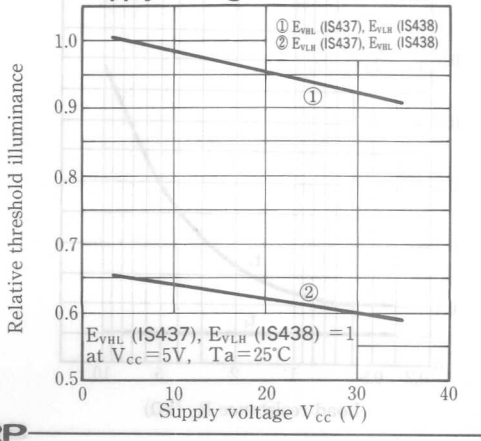


Fig. 2 Relative Threshold Illuminance vs. Supply Voltage



4

Fig. 3 Low Level Output Voltage vs. Low Level Output Current

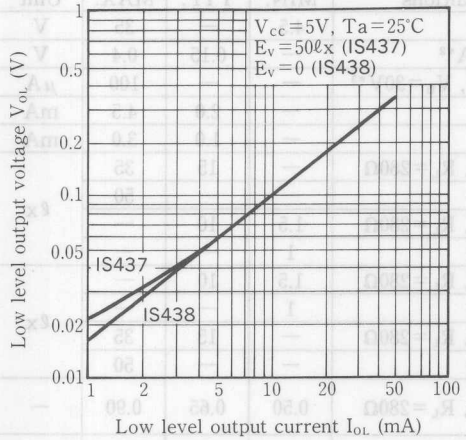


Fig. 4 Low Level Output Voltage vs. Ambient Temperature

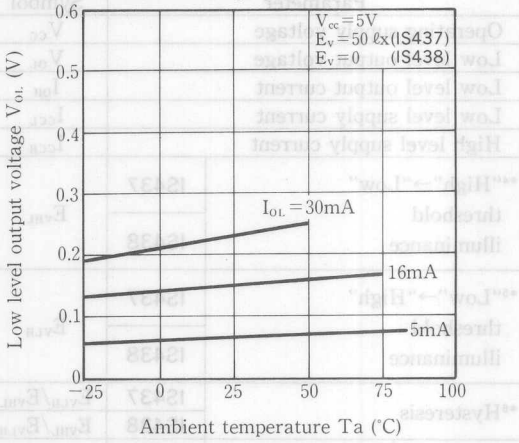


Fig. 5 Supply Current vs. Ambient Temperature

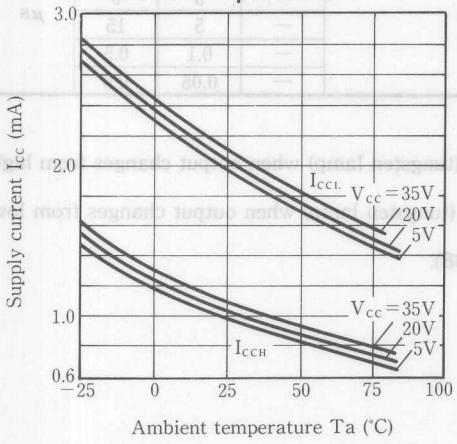


Fig. 6 Propagation Time vs. Illuminance

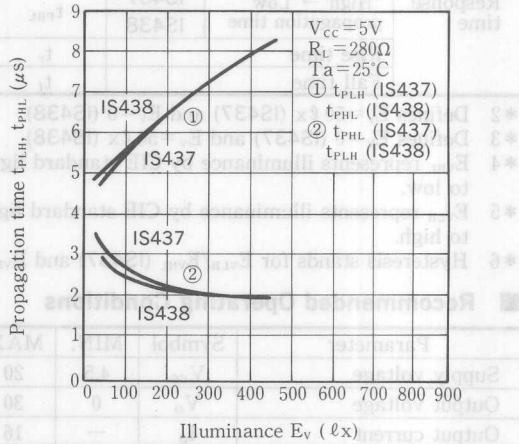
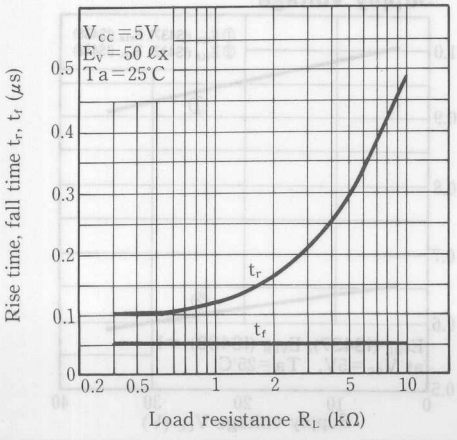
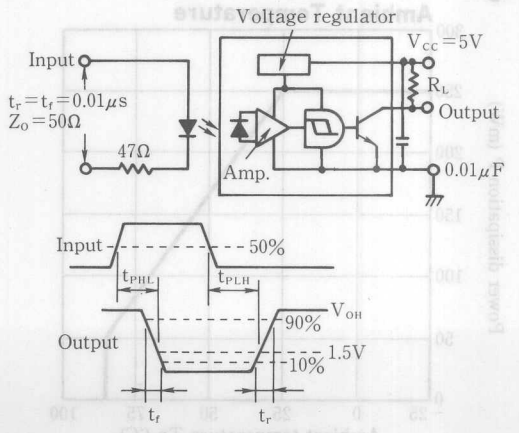


Fig. 7 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time (IS437)



Test Circuit for Resesponse Time (IS438)

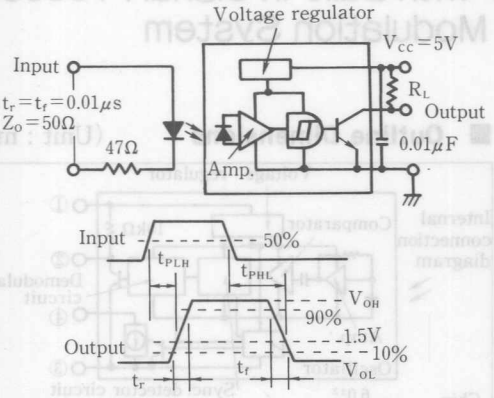


Fig. 8 Sensitivity Diagram (Ta=25°C)

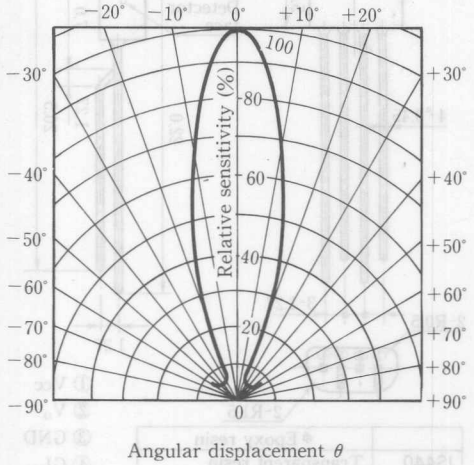
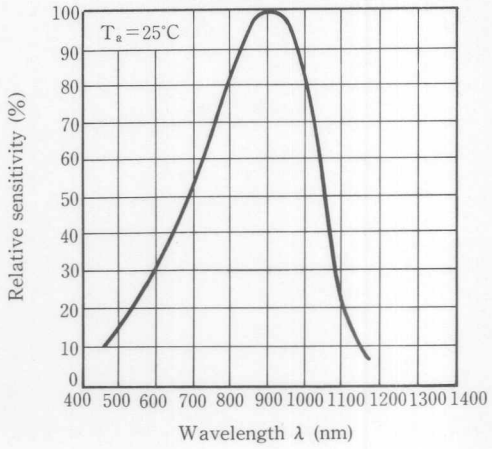


Fig. 9 Spectral Sensitivity



4

IS440/IS441F OPIC Light Detector with Built-in Signal Processing Circuit for Light Modulation System

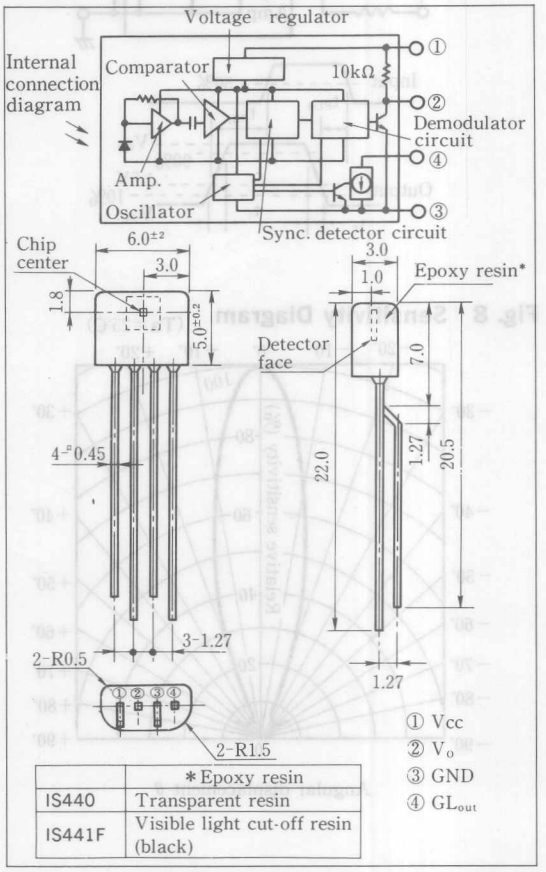
■ Features

1. Impervious to external disturbing lights due to light modulation system
2. Built-in pulse driver circuit and sync. detector circuit on the emitter side
3. A wide range of operating supply voltages (Vcc: 4.5～16V)
4. Visible light cut-off resin (IS441F)

■ Applications

1. Optoelectronic switches
2. Copiers, printers, facsimiles

■ Outline Dimensions (Unit : mm)



	*Epoxy resin
IS440	Transparent resin
IS441F	Visible light cut-off resin (black)

※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Supply voltage		Vcc	−0.5～16	V
Output	Output voltage	V_O	16	V
	Output current	I_O	50	mA
GL output *1	Output voltage	V_{GL}	16	V
Power dissipation		P	250	mW
Operating temperature		T_{opr}	−25～+60	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

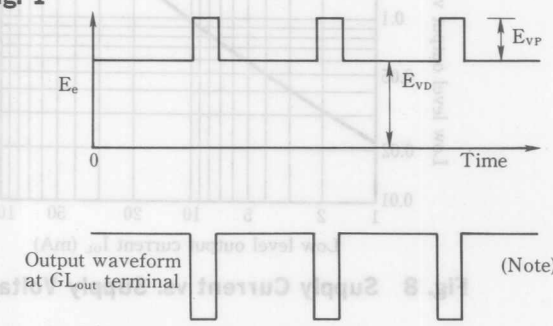
*1 Applies to GL_{out} terminal.
*2 For 5 seconds at the position of 3.3mm from the bottom face of resin package

■ Electro-optical Characteristics (Vcc=5V, Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage			Vcc		4.5	—	16	V
Supply current			Icc	V_o, GL_{out} terminals shall be opened.	—	3.5	7.0	mA
Output	Low level output voltage		V_{OL}	I_{OL}=16mA, E_{VP}=500ℓx, E_{VD}=0 *3	—	0.15	0.35	V
	High level output voltage	IS440	V_{OH}	$E_{VP}=E_{VD}=0$ *3	4.95	—	—	V
		IS441F			4.97	—	—	V
	Output short-circuit current		I_{OS}	$E_{VP}=E_{VD}=0$ *3	0.25	0.5	1.0	mA
GL output	Low level output current		I_{GL}	V_{GL}=1.2V	40	55	70	mA
	*4Pulse cycle		t_p		70	130	220	μs
	*4Pulse width		t_w		4.4	8	13.7	μs
*5"Low → High" threshold irradiance		IS440	E_{epLH}	$E_{eD}=0$ *3 *6 Light emitting diode (λp=940nm)	—	1.0	5.70	μW/mm²
		IS441F			—	0.4	2.66	μW/mm²
*5"High → Low" threshold irradiance		IS440	E_{epHL}		—	1.5	6.0	μW/mm²
		IS441F			—	0.7	2.8	μW/mm²
Hysteresis			E_{epLH}/E_{epHL}		0.45	0.65	0.95	—
Response time	"High→Low" propagation time		t_{PHL}	*6	—	400	670	μs
	"Low→High" propagation time		t_{PLH}	*6	—	400	670	μs
*7External disturbing light illuminance		IS440	E_{VDX}	E_{ep}=18μW/mm², λp=940nm	2000	7200	—	ℓx
		IS441F		E_{ep}=7.5μW/mm², λp=940nm	2000	4500	—	ℓx

*3 E_{VP} represents illuminance of signal light in sync with the low level timing of output at GL_{out} terminal.
Light source: Infrared light emitting diode (λp=940nm)
E_{VD} represents illuminance of DC light. For detail, see Fig. 1. Note that the light source is CIE standard light source A.

Fig. 1



(Note) Output waveform at GL_{out} terminal with the IS440/IS441F connected as shown in Fig. 3.

*4 Pulse cycle (t_P), pulse width (t_W) are defined as shown in Fig. 2.
The waveform shown in Fig. 2 is the output voltage waveform at GL_{out} terminal with IS440/IS441F connected as shown in Fig. 3.

Fig. 2

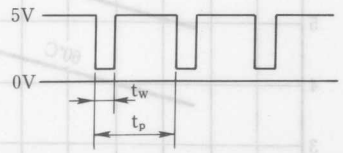
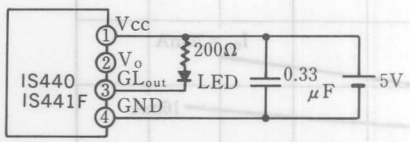


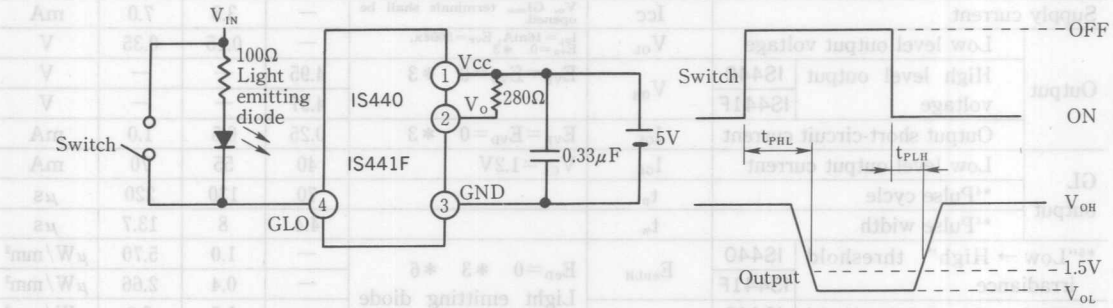
Fig. 3



*5 Defined as E_{ep} that causes the output to go "Low to High" (or "High to Low").

*6 Test circuit for response time, and threshold irradiance is shown in Fig. 4

Fig. 4



Light emitting diode: Peak emissinon wavelength λp=940nm

*7 E_{VDX}: Defined as the E_{VD} at the limit of normal operation range.

Fig. 5 Total Power Dissipation vs. Ambient Temperature

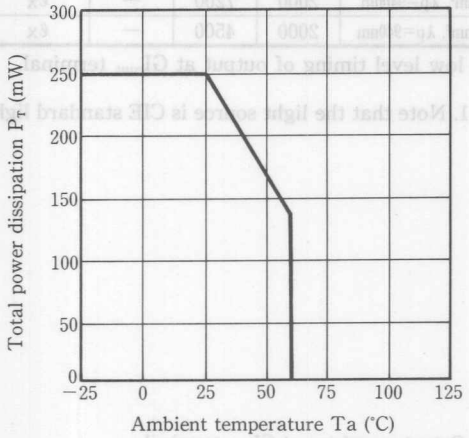


Fig. 6 Low Level Output Voltage vs. Low Level Output Current

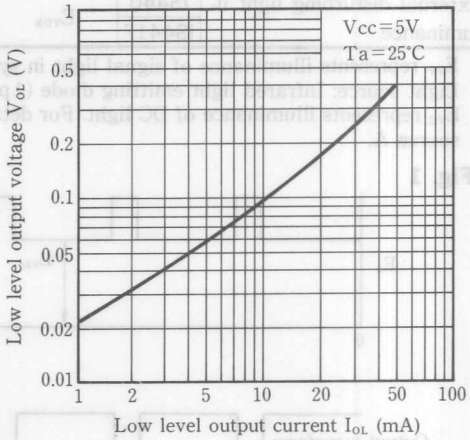


Fig. 7 Low Level Output Voltage vs. Ambient Temperature

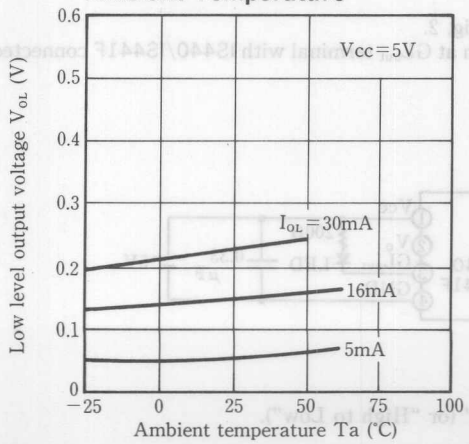


Fig. 8 Supply Current vs. Supply Voltage

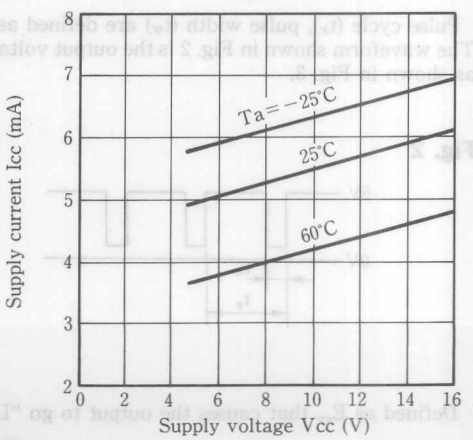


Fig. 9 Low Level Output Current vs. Supply Voltage

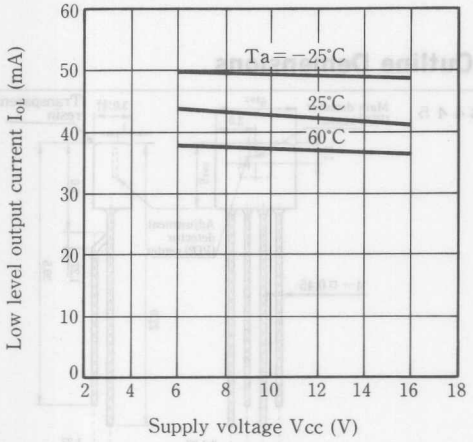


Fig. 10 Sensitivity Diagram

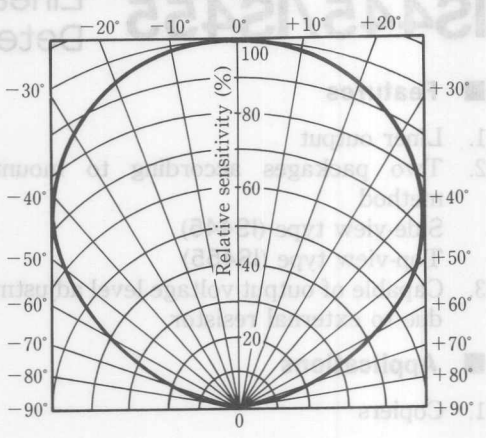
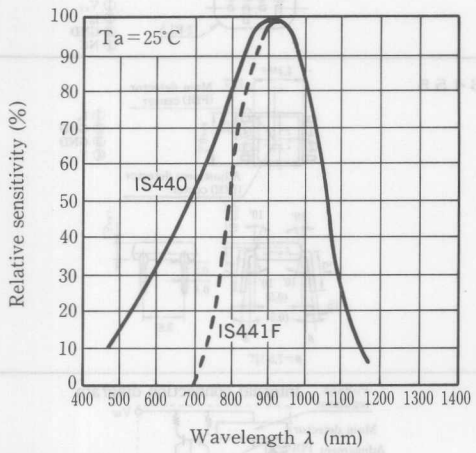
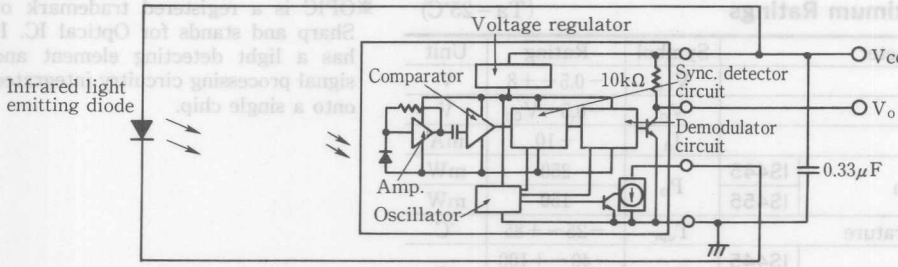


Fig. 11 Spectral Sensitivity



■ Basic Circuit



IS445/IS455 Linear Output Type OPIC Light Detector

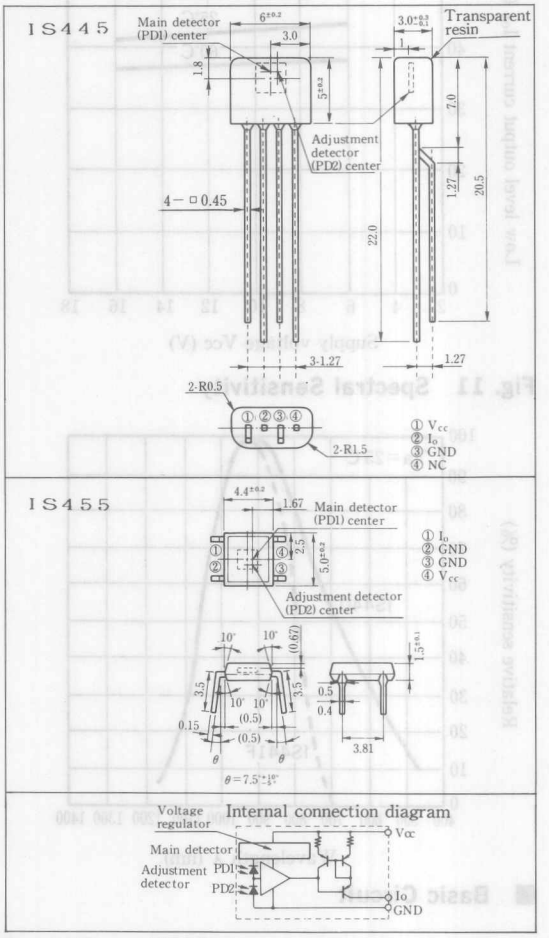
■ Features

1. Liner output
2. Two packages according to mounting method
   Side-view type (IS445)
   Top-view type (IS455)
3. Capable of output voltage level adjustment due to external resistor

■ Applications

1. Copiers

■ Outline Demensions



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Supply voltage		V_{CC}	−0.5~+8	V
Output voltage		V_O	−0.5~V_{CC}	V
Output current		I_O	−10	mA
Power dissipation	IS445	P_O	250	mW
	IS455		150	mW
Operating temperature		T_{opr}	−25~+85	°C
Storage temperature	IS445	T_{stg}	−40~+100	°C
	IS455		−40~+85	
*1Soldering temperature		T_{sol}	260	°C

*1 For 3 seconds at the position of 1mm from the bottom face of resin package. (IS455)
Immersed up to bending portion, for 5 seconds (IS445)

※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Electro-optical Characteristics

(Ta=25°C, V_{CC}=5V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply current	I_{CC}	E_V=0 ℓx	0.2	0.55	1.0	mA
Output current 1	I_{O1}	E_V=10 ℓx*2	−6.5	−10	−13.5	μA
Output current 2	I_{O2}	E_V=1,000 ℓx*2	−0.65	−1	−1.35	mA
*3Output current ratio	R_{IO}		92	100	108	—
Dark output current	I_{od}	E_V=0	—	−10	−500	nA
Peak sensitivity wavelength	λ_P		—	700	—	nm

*2 E_V: Illuminance by CIE standard light source A (tungsten lamp)

*3 $RIO=\frac{I_{O2}}{I_{O1}}$

■ Recommended Operating Conditions

Parameter	Symbol	MIN.	MAX.	Unit
Supply voltage	V_{CC}	4.5	5.5	V
*4Illuminamce	E_V	10	5000	ℓx
Output voltage	V_O	0	V_{CC}−1.5	V
Oparating temperature	T_{opr}	−10	70	°C

*4 E_V: Illuminamce by standard light source A (tungsten lamp)

4

Fig. 1 Power Dissipation vs. Ambient Temperature

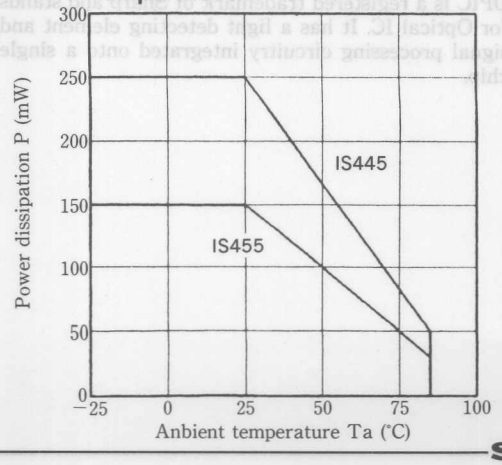
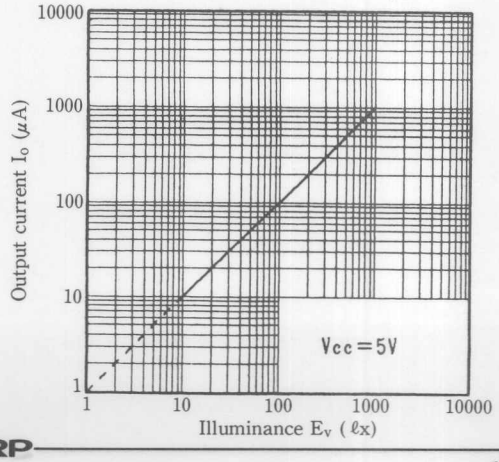


Fig 2 Output Current vs. Illuminance



IS450 OPIC Light Detector with Built-in Signal Processing Circuit for Light Modulation System

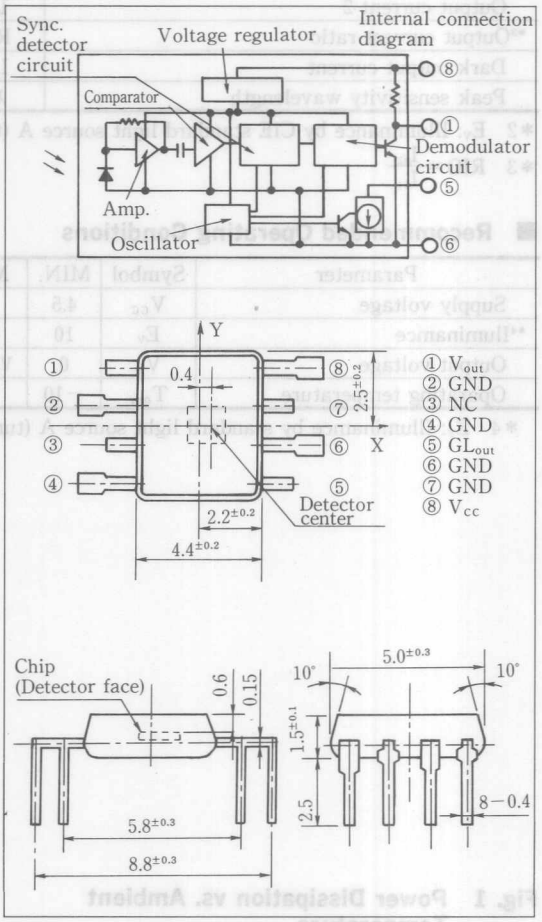
■ Features

1. Impervious to external disturbing lights due to light modulation system
2. Built-in pulse driver circuit and sync. detector circuit on the emitter side
3. A wide range of operating supply voltages (V_{CC}: 4.5~9V)
4. 1.5mm thin dual-in-line package

■ Applications

1. Optoelectronic switches
2. Copiers, printers, facsimiles

■ Outline Dimensions (Unit : mm)



*OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Supply voltage		V_{CC}	−0.5~9	V
Output	Output voltage	V_O	9	V
	Output current	I_O	16	mA
GL output *1	Output voltage	V_{GL}	9	V
Power dissipation		P	150	mW
Operating temperature		T_{opr}	−25~+60	°C
Storage temperature		T_{sig}	−40~+85	°C
*2Soldering temperature		T_{sol}	260	°C

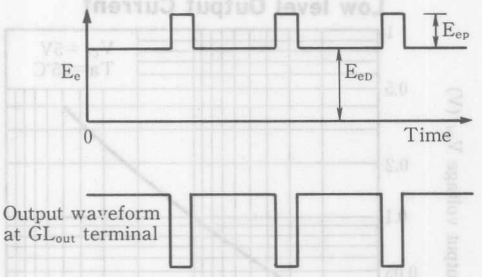
*1 Applies to GL_{out} terminal.
*2 For 5 seconds at the position of 1mm from the bottom face of resin package.

■ Electro-optical Characteristics (V_{CC}=5V, Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage		V_{CC}		4.5	—	9	V
Supply current		I_{CC}	V_O, GL_{out} terminals shall be opened.	—	3.5	7.0	mA
Output	Low level output voltage	V_{OL}	I_{OL}=16mA, E_{VP}=500ℓx, E_{VD}=0 *4	—	0.15	0.35	V
	High level output voltage	V_{OH}	$E_{VP}=E_{VD}=0$ *4	4.95	—	—	V
	Output short circuit current	I_{OS}	$E_{VP}=E_{VD}=0$ *4	0.25	0.5	1.0	mA
GL output	Low level output current	I_{GL}	V_{GL}=1.2V	40	55	70	mA
	*5Pulse cycle	t_p		70	130	220	μs
	*5Pulse width	t_w		4.4	8	13.7	μs
*6"Low→High" threshold irradiance		E_{epLH}	E_{eD}=0, Light emitting diode (λp=940nm) *4 *7	—	0.5	2.1	μW/mm²
*6"High→Low" threshold irradiance		E_{epHL}		—	0.8	2.2	μW/mm²
Hysteresis		E_{epLH}/E_{epHL}		0.45	0.65	0.95	—
Response time	"High→Low" propagation time	t_{pHL}	*7	—	400	670	μs
	"Low→High" propagation time	t_{pLH}	*7	—	400	670	μs
External disturbing light illuminance		E_{VDX}	E_{ep}=6.6μW/mm², λp=940nm	750	3600	—	ℓx

*4 E_{ep} represents illuminance of signal light in sync with the low level timing of output at GL_{out} terminal. Light source: Infrared light emitting diode (λp=940nm)
E_{eD} represents illuminance of DC light. For detail, see Fig. 1. Note that the light source in CIE standard light source A.

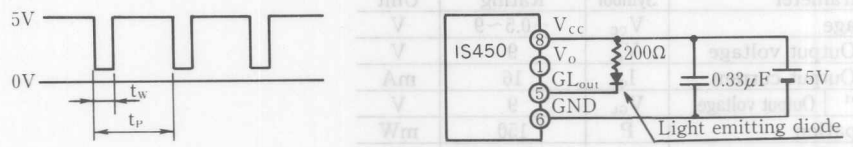
Fig. 1



(Note) Fig. 1 shows the output voltage waveform at GL_{out} terminal with IS450 connected as shown in Fig. 3.

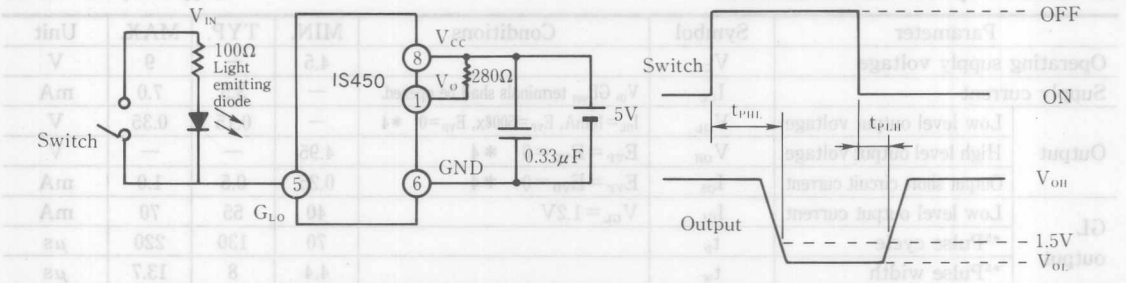
*5 Pulse cycle (t_p), pulse width (t_w) are defined as shown in Fig. 2.
The waveform shown in Fig. 2 is the output voltage waveform at GL_{out} terminal with IS450 connected as shown in Fig. 3.

Fig. 2



*6 Defined as E_{ep} that causes the output to go "Low→High" (or "High→Low").
*7 Test circuit for response time, threshold irradiance is shown in Fig. 4.

Fig. 3



Light emitting diode: Peak emission wavelength λp=940nm

*8 E_{VDX}: Defined as the E_{VD} at the limit of normal operation range.

Fig. 1 Total Power Dissipation vs. Ambient Temperature

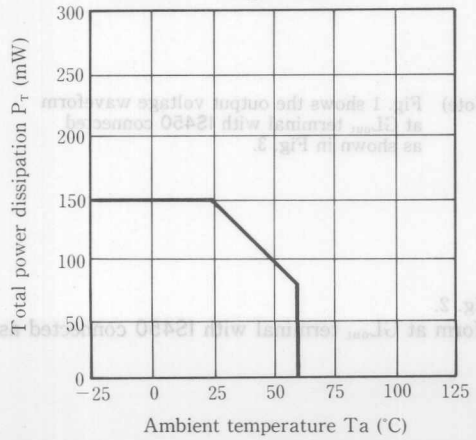


Fig. 2 Low Level Output Voltage vs. Low level Output Current

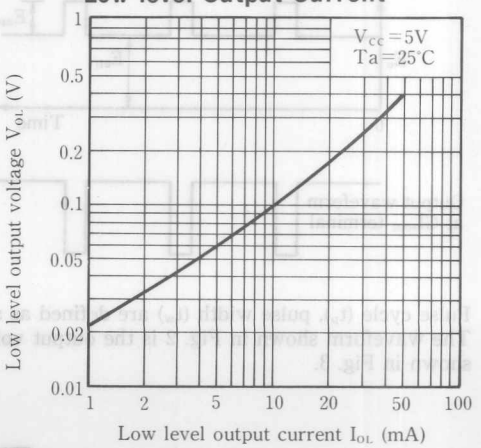


Fig. 3 Low Level Output Voltage vs. Ambient Temperature

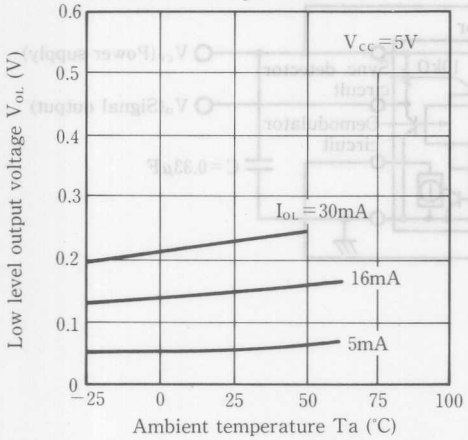


Fig. 4 Supply Current vs. Supply Voltage

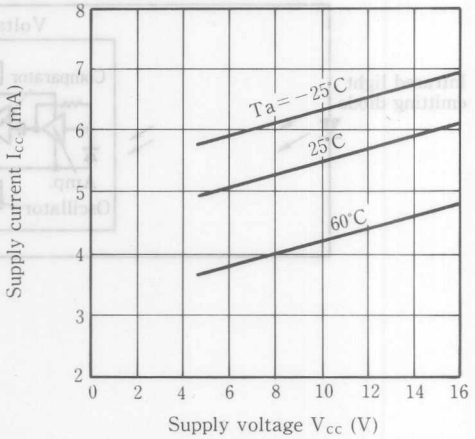


Fig. 5 Low Level Output Current vs. Supply Voltage

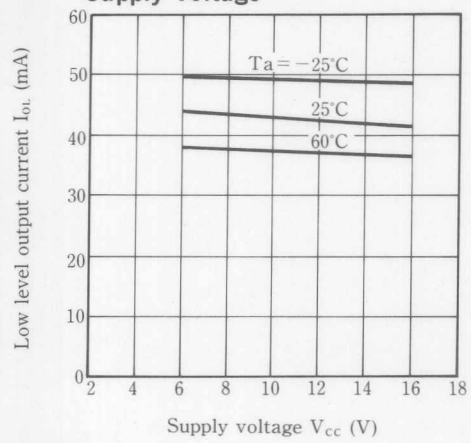


Fig. 6 Sensitivity Diagram

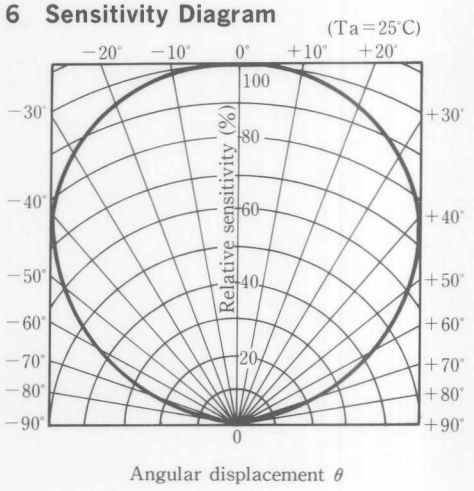
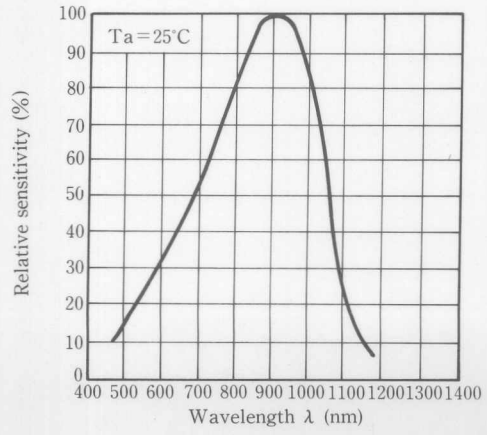
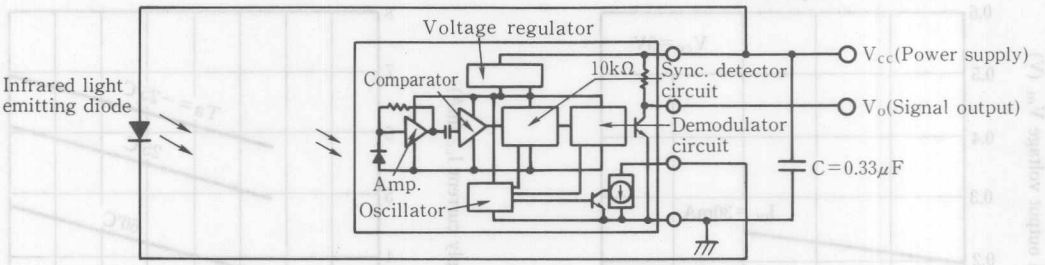


Fig. 7 Spectral Sensitivity



4

■ Basic Circuit



IS486 Built-in Amp. Type Opic Light Detector

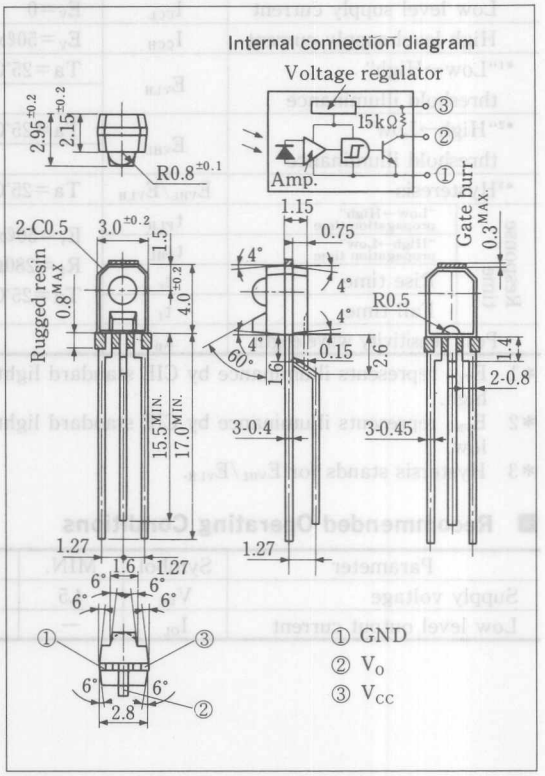
■ Features

1. Compact
2. Built-in Schmidt trigger circuit
3. High sensitivity
   (E_{VLH}: MAX. 35ℓx at Ta=25°C)
4. A wide range of operating supply voltages
   (V_{CC}: 4.5~17V)
5. LSTTL and TTL compatible output

■ Applications

1. Floppy disk drives
2. Copiers, printers, facsimiles
3. VCRs, cassette tape recorder
4. Automatic vending machines

■ Outline Dimensions (Unit : mm)



*OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	−0.5~+17	V
Low level output current	I_{OL}	50	mA
Power dissipation	P	175	mW
Operating temperature	T_{opr}	−25~+85	°C
Storage temperature	T_{stg}	−40~+100	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 1.4mm from the bottom face of resin package.

■ Electro-optical Characteristics

(Ta=0~+70°C, V_{CC}=5V unless otherwise specified.)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Low level output voltage		V_{OL}	I_{OL}=16mA, E_V=0	—	0.15	0.4	V
High level output voltage		V_{OH}	E_V=50ℓx	3.5	—	—	V
Low level supply current		I_{CCL}	E_V=0	—	1.7	3.8	mA
High level supply current		I_{CCH}	E_V=50ℓx	—	0.7	2.2	mA
*1"Low→High" threshold illuminance		E_{VLH}	Ta=25°C	—	15	35	ℓx
				—	—	50	
*2"High→Low" threshold illuminance		E_{VHL}	Ta=25°C	1.5	10	—	ℓx
				1	—	—	
*3Hysteresis		E_{VHL}/E_{VLH}	Ta=25°C	0.50	0.65	0.90	—
Response time	"Low→High" propagation time	t_{PLH}	E_V=50ℓx, R_L=280Ω, Ta=25°C	—	3	9	μs
	"High→Low" propagation time	t_{PHL}		—	5	15	
	Rise time	t_r		—	0.1	0.5	
	Fall time	t_f		—	0.05	0.5	
Peak sensitivity wavelength		λ_P		—	900	—	nm

*1 E_{VLH} represents illuminance by CIE standard light source A (tungsten lamp) when output goes from low to high.

*2 E_{VHL} represents illuminance by CIE standard light source A (tungsten lamp) when output goes from high to low.

*3 Hystersis stands for E_{VHL}/E_{VLH}.

■ Recommended Operating Conditions

(Ta=0~+70°C)

Parameter	Symbol	MIN.	MAX.	Unit
Supply voltage	V_{CC}	4.5	17	V
Low level output current	I_{OL}	—	16	mA

Fig. 1 Low Level Output Current vs. Ambient Temperature

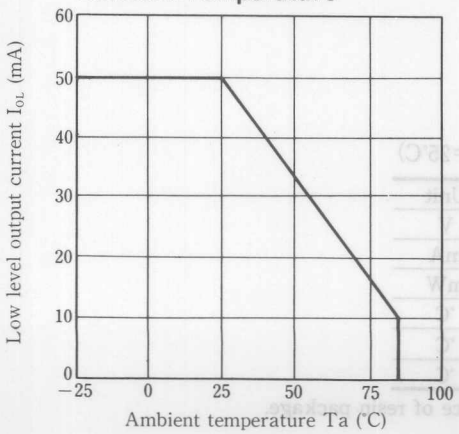


Fig. 2 Power Dissipation vs. Ambient Temperature

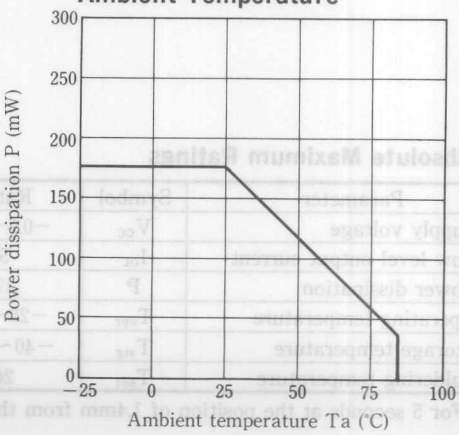


Fig. 3 Relative Threshold Illuminance vs. Supply Voltage

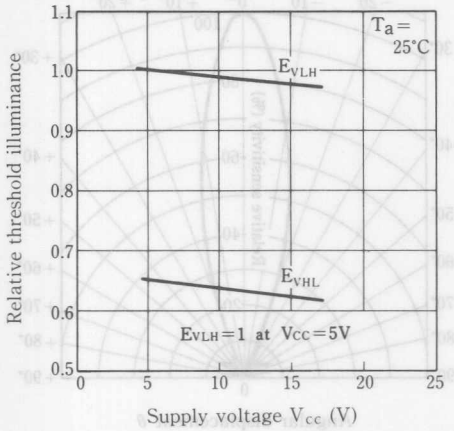


Fig. 4 Low Level Output Voltage vs. Low Level Output Current

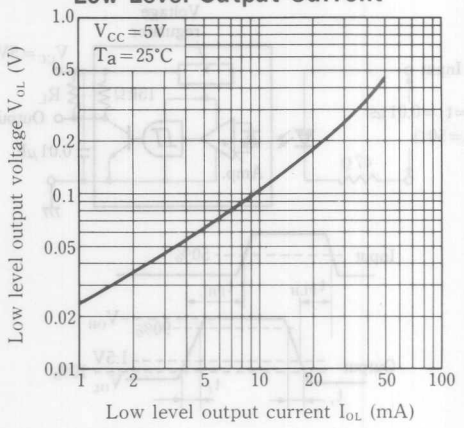


Fig. 5 Low Level Output Voltage vs. Ambient Temperature

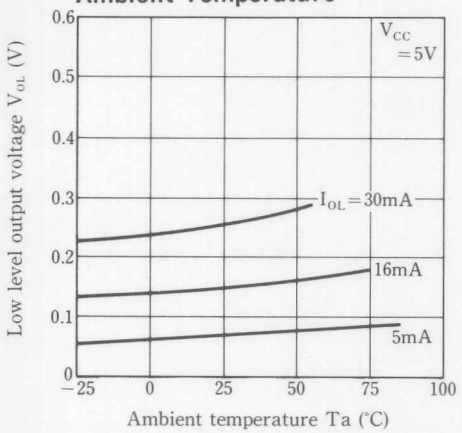


Fig. 6 Supply Current vs. Ambient Temperature

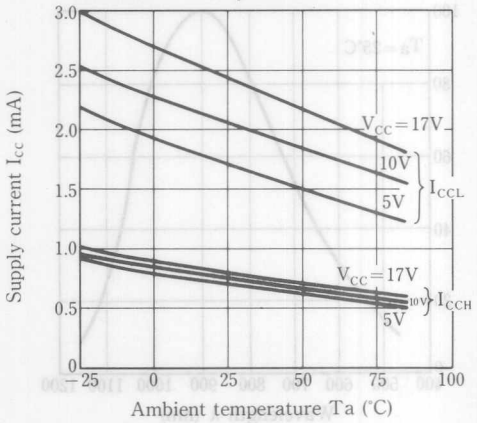


Fig. 7 Propagation Time vs. Illuminance

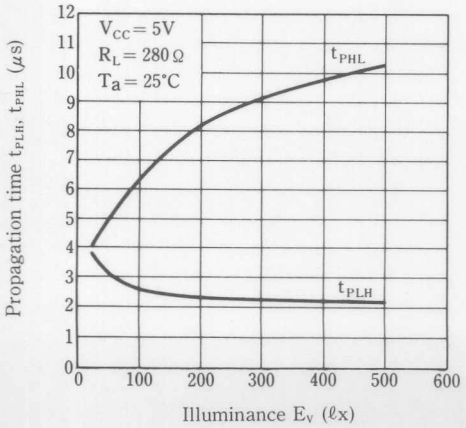
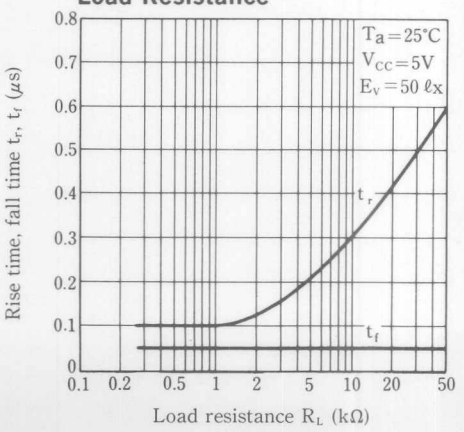


Fig. 8 Rise Time, Fall Time vs. Load Resistance



4

Test Circuit for Response Time

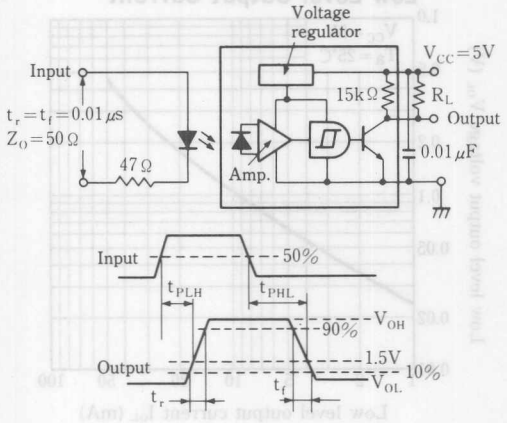
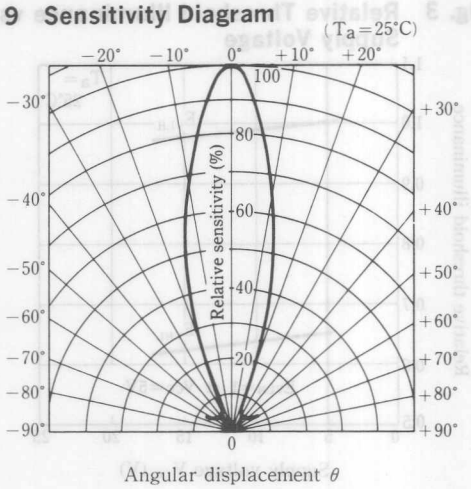
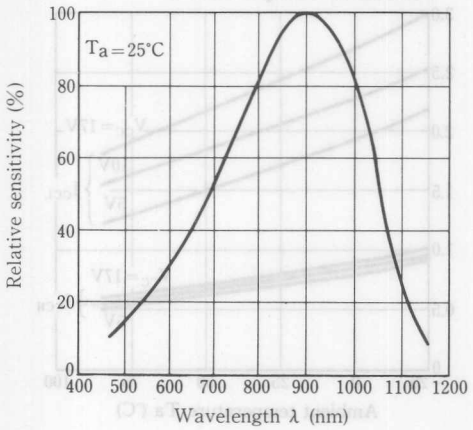


Fig. 9 Sensitivity Diagram



Angular displacement θ

Fig. 10 Spectral Sensitivity



Phototransistors

5

PT360/PT360F Compact Type Phototransistor

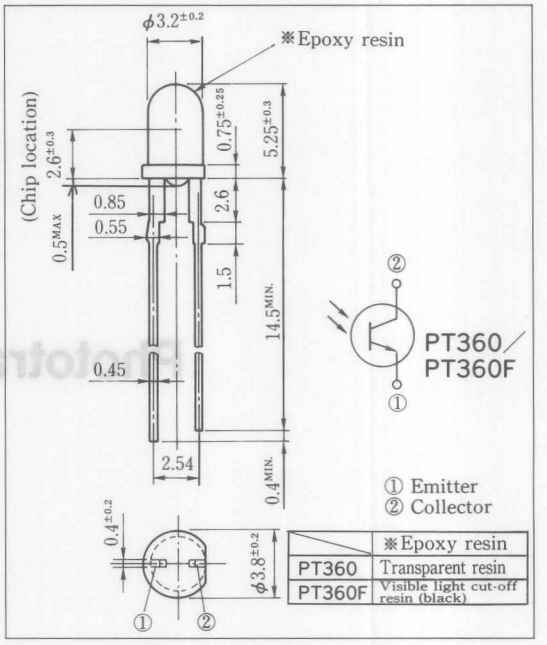
■ Features

1. ϕ3.2mm compact type epoxy resin package
2. Intermediate acceptance($\triangle\theta$: TYP. $\pm$20°)
3. Lead pins space: 2.54mm
4. Visible light cut-off type: PT360F

■ Applications

1. VCRs, Video camera
2. Floppy disk drives
3. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Emitter-collector voltage	V_{ECO}	6	V
Collector current	I_C	20	mA
Collector power dissipation	P_C	50	mW
Operating temperature	T_{opr}	−25~+85	°C
Storage temperature	T_{stg}	−25~+85	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 2.6mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Collector current		I_C	V_{CE}=5V, E_V=100 lx (E_e=0.52mW/cm²)	75	200	420	μA
Collector dark current		I_{CEO}	V_{CE}=20V, E_e=0	—	2×10^{-9}	10^{-7}	A
*2Collector-emitter saturation voltage		$V_{CE(sat)}$	I_C=0.5mA, E_e=10mW/cm²	—	0.2	0.4	V
Peak sensitivity wavelength	PT360	λ_P		—	800	—	nm
	PT360F			—	860	—	nm
Response time (Rise)		t_r	V_{CE}=20V, I_C=1mA	—	10	40	μs
Response time (Fall)		t_f	R_L=1kΩ	—	8	35	μs

*2 E_V, E_e : Illuminance, irradiance by CIE standard light source A (tungsten lamp)

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

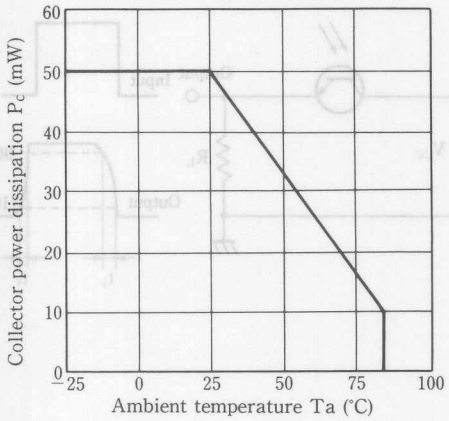


Fig. 2 Collector Dark Current vs. Ambient Temperature

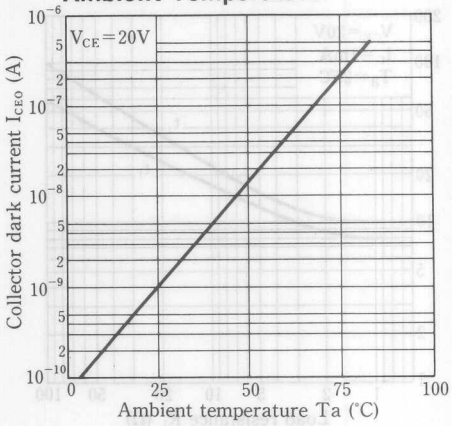


Fig. 3 Relative Collector Current vs. Ambient Temperature

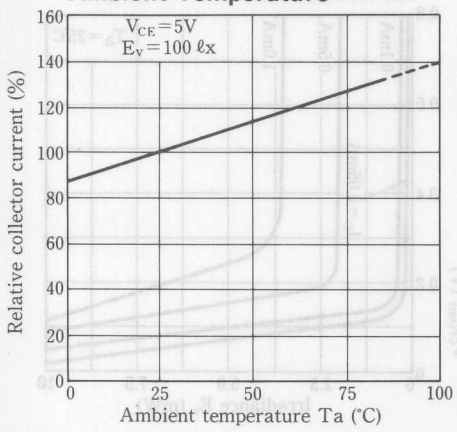


Fig. 4 Collector Current vs. Irradiance

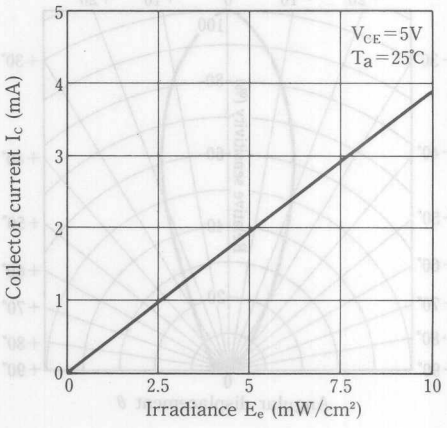


Fig. 5 Collector Current vs. Collector-emitter Voltage

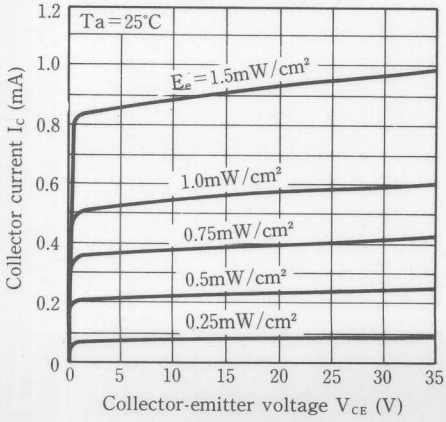
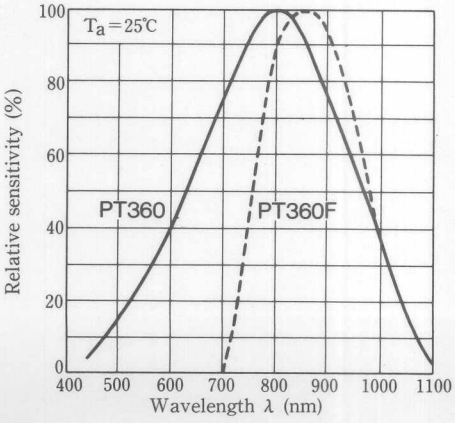
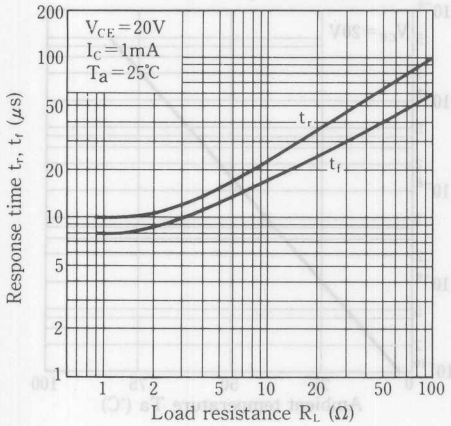


Fig. 6 Spectral Sensitivity



5

Fig. 7 Response Time vs. Load Resistance



Test Circuit for Response Time

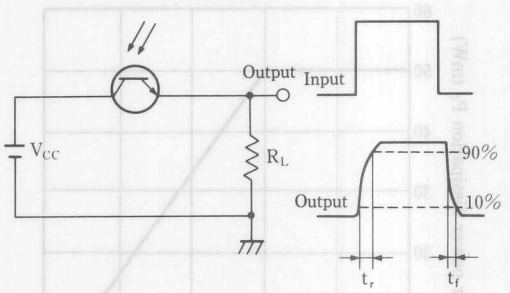


Fig. 8 Sensitivity Diagram (T_a=25°C)

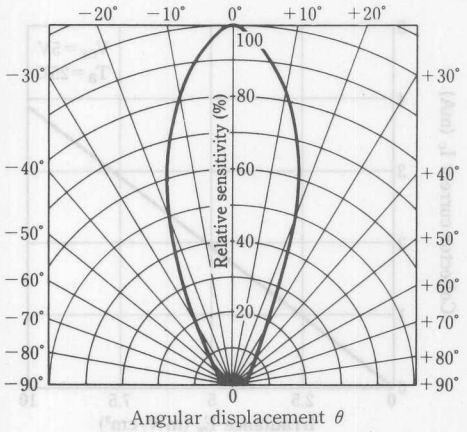
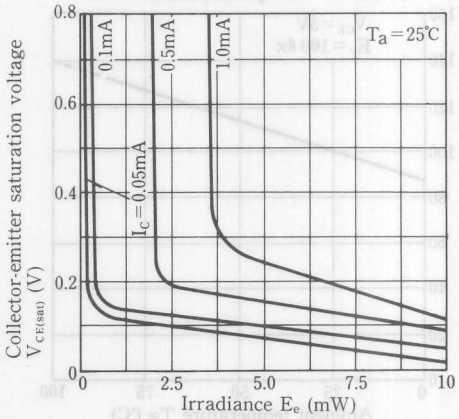


Fig. 9 Collector-emitter Saturation Voltage vs. Irradiance



PT361/PT361F

Compact Type Intermediate acceptance Phototransistor

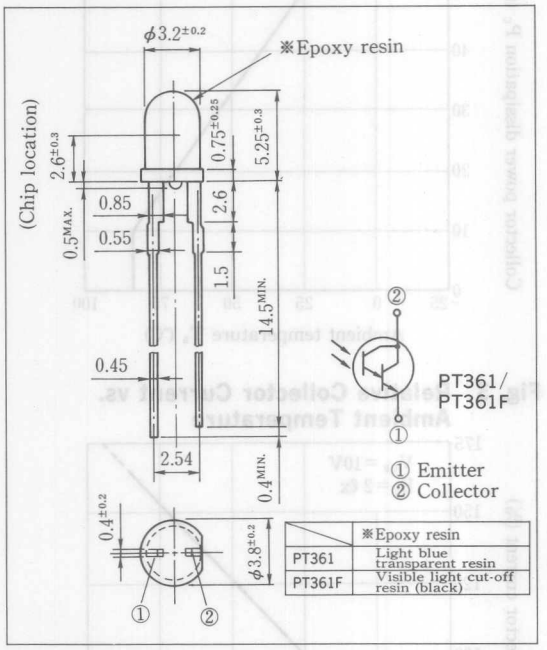
■ Features

1. ϕ3.2mm compact epoxy resin package
2. High sensitivity
   (I_C : MIN. 0.1mA at E_V=2ℓx)
3. Intermediate acceptance ($\Delta\theta$: TYP. ±20°)
4. Lead pins space : 2.54mm
5. Visible light cut-off type : PT361F

■ Applications

1. VCRs, Video cameras
2. Floppy disk drives
3. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Emitter-collector voltage	V_{ECO}	6	V
Collector current	I_C	50	mA
Collector power dissipation	P_C	50	mW
Operating temperature	T_{opr}	−25~+85	°C
Storage temperature	T_{stg}	−25~+85	°C
*1 Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 2.6mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2 Collector current		I_C	V_{CE}=10V, E_V=2ℓx (E_e=0.01mW/cm²)	0.1	0.2	0.467	mA
Collector dark current		I_{CEO}	V_{CE}=10V, E_e=0	—	—	10^{-6}	A
*2 Collector-emitter saturation voltage		$V_{CE(sat)}$	I_C=2.5mA, E_e=1mW/cm²	—	0.8	1.0	V
Peak sensitivity wavelength	PT361	λ_P		—	800	—	nm
	PT361F			—	860	—	nm
Response time (Rise)		t_r	V_{CE}=2V, I_C=10mA	—	100	400	μs
Response time (Fall)		t_f	R_L=100Ω	—	100	400	μs

*2 E_V, E_e : Illuminance, irradiance by CIE standard light source A (tungsten lamp)

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Fig. 1 Collector Power Dissipation vs. Ambient Temperature

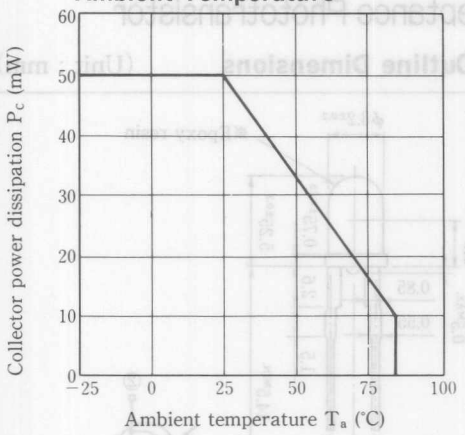


Fig. 2 Collector Dark Current vs. Ambient Temperature

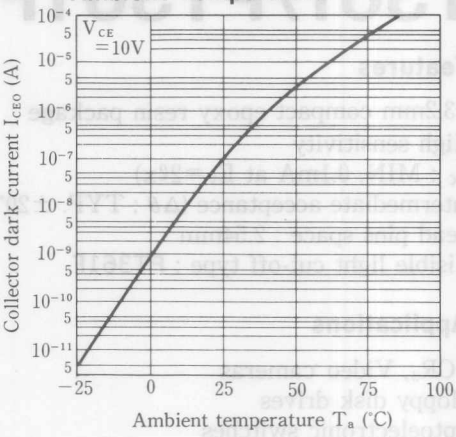


Fig. 3 Relative Collector Current vs. Ambient Temperature

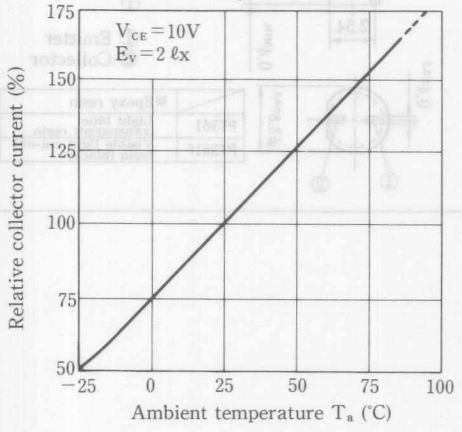


Fig. 4 Collector Current vs. Irradiance

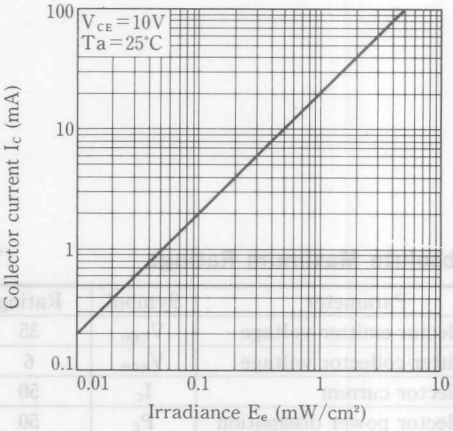


Fig. 5 Collector Current vs. Collector-emitter Voltage

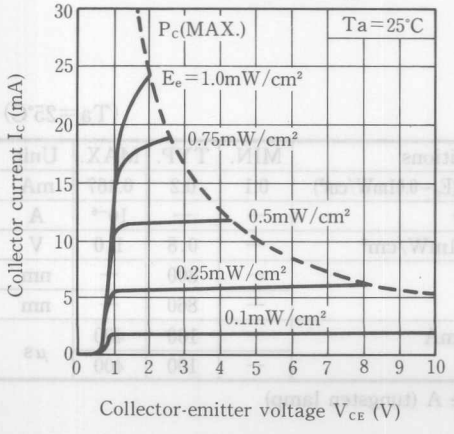


Fig. 6 Spectral Sensitivity

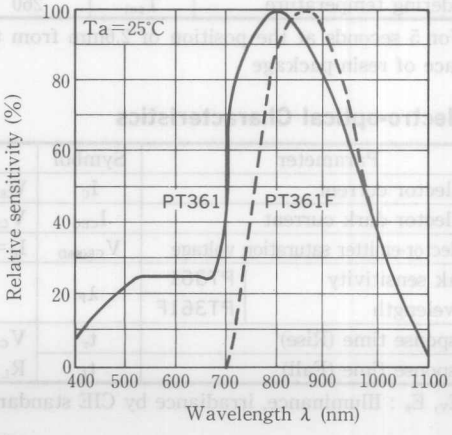
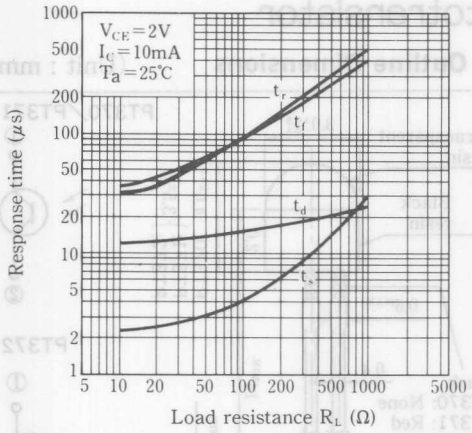


Fig. 7 Response Time vs. Load Resistance



Test Circuit for Response Time

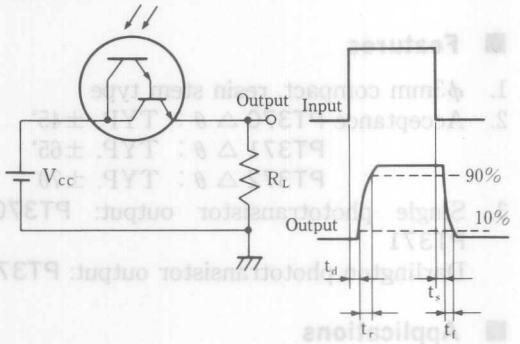


Fig. 8 Sensitivity Diagram (T_a=25°C)

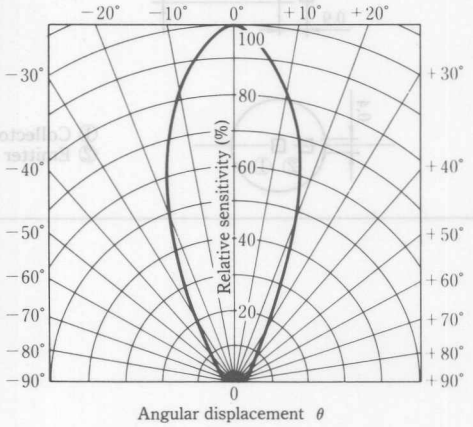
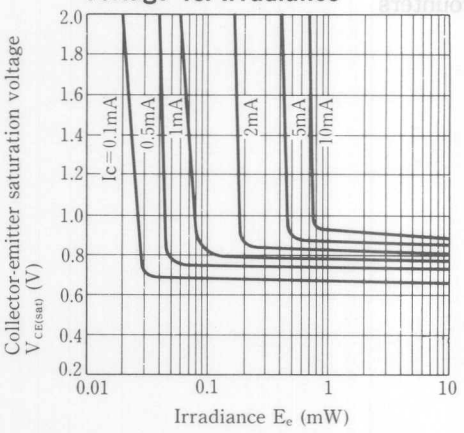


Fig. 9 Collector-emitter Saturation Voltage vs. Irradiance



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PT370/PT371/PT372 Compact, Stem Type Phototransistor

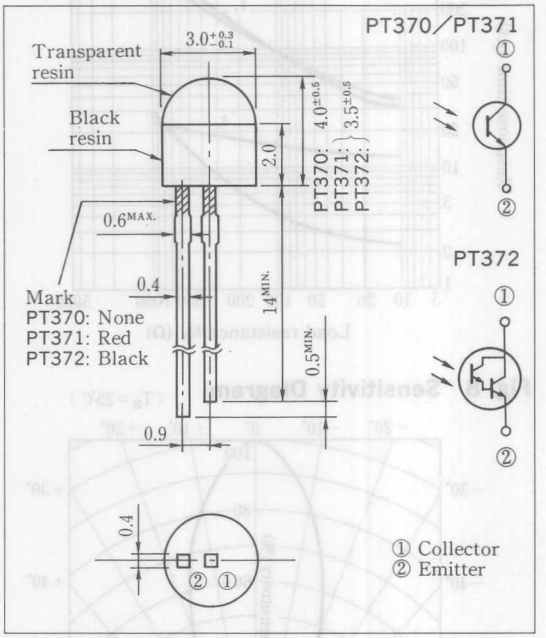
■ Features

1. ϕ3mm compact, resin stem type
2. Acceptance PT370 $\triangle\theta$: TYP. $\pm 45°$
   PT371 $\triangle\theta$: TYP. $\pm 65°$
   PT372 $\triangle\theta$: TYP. $\pm 70°$
3. Single phototransistor output: PT370/PT371
   Darlington phototransistor output: PT372

■ Applications

1. Floppy disk drives
2. VCRs,
3. Automatic stroboscopes
4. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Collector-emitter voltage		V_{CEO}	35	V
Emitter-collector voltage		V_{ECO}	6	V
Collector current	PT370/PT371	I_C	20	mA
	PT372		50	
Collector power dissipation		P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−25～+85	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 3 seconds at the position of 1.5mm from the bottom face of resin package

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Collector current	PT370	I_C	*3	100	300	900	μA
	PT371		Ev=100ℓx, V_{CE}=5V	100	—	900	
	PT372		(PT372: V_{CE}=2V)	3.0	—	23	mA
Collector dark current	PT370/PT371	I_{CEO}	E_e=0, V_{CE}=20V	—	2.0	100	nA
	PT372		E_e=0, V_{CE}=10V	—	—	1.0	μA
Collector-emitter saturation voltage	PT370/PT371	$V_{CE(sat)}$	*3E_e=10mW/cm², I_C=0.5mA	—	0.2	0.4	V
	PT372		*3E_e=1mW/cm², I_C=2.5mA	—	0.8	1.0	
Peak sensitivity wavelength		λp	—	—	800	—	nm
Response time (Rise)	PT370/PT371	t_r	V_{CC}=20V, I_C=1mA, R_L=1kΩ	—	10	40	μs
	PT372		V_{CE}=2V, I_C=10mA, R_L=100Ω	—	100	400	μs
Response time (Fall)	PT370/PT371	t_f	V_{CC}=20V, I_C=1mA, R_L=1kΩ	—	8	35	μs
	PT372		V_{CE}=2V, I_C=10mA, R_L=100Ω	—	100	400	μs
Half intensity angle	PT370	Δθ	—	—	±45	—	deg.
	PT371			—	±65	—	
	PT372			—	±70	—	

*2 The collector current (I_C) shall be classified into the ranks as follows before delivery.

Rank	Collector current I_C		
	PT370 (μA)	PT371 (μA)	PT372 (mA)
A	100~216	100~244	3.0~9.66
B	170~320	192~463	7.14~23.0
C	252~533	363~900	—
D	419~900	—	—

*3 E_v, E_e: Illuminance, irradiance by CIE standard light source A (tungsten lamp)

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

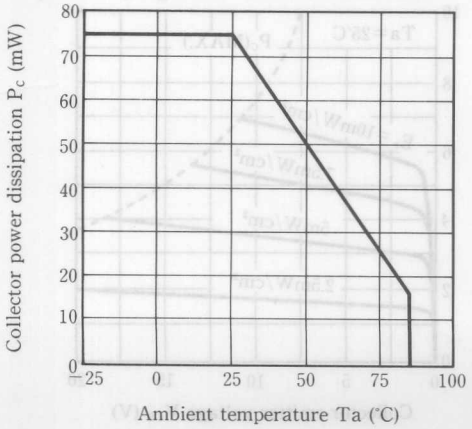
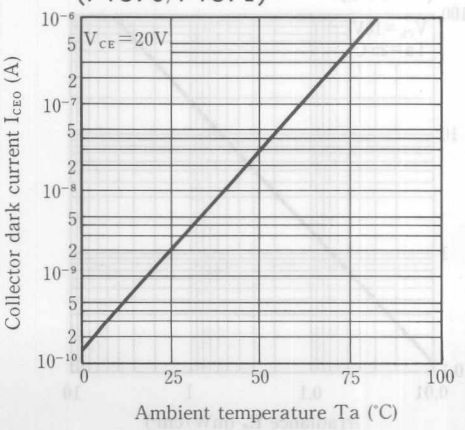


Fig. 2 Collector Dark Current vs. Ambient Temperature (PT370/PT371)



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Fig. 3 Collector Dark Current vs. Ambient Temperature (PT372)

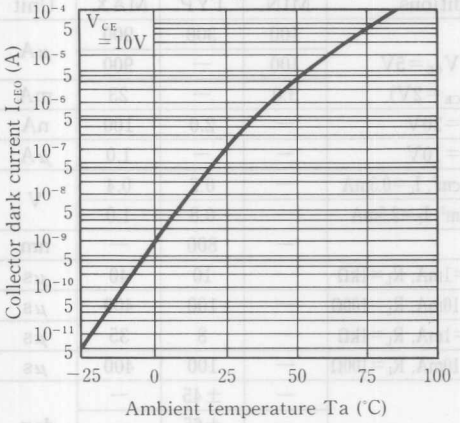


Fig. 4 Relative Collector Current vs. Ambient Temperature (PT370/PT371)

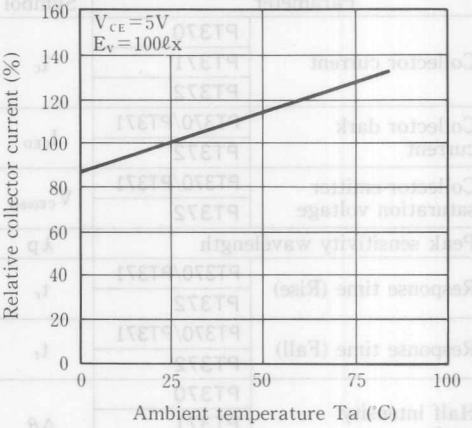


Fig. 5 Relative Collector Current vs. Ambient Temperature (PT372)

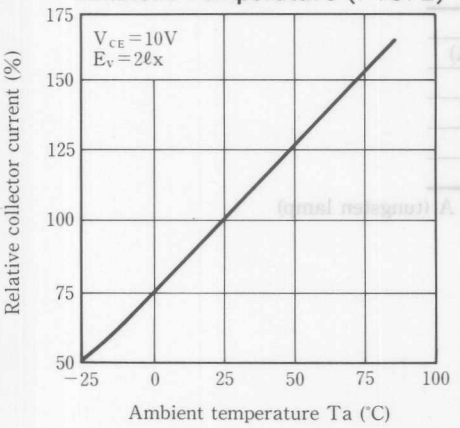


Fig. 6 Collector Current vs. Irradiance (PT370/PT371)

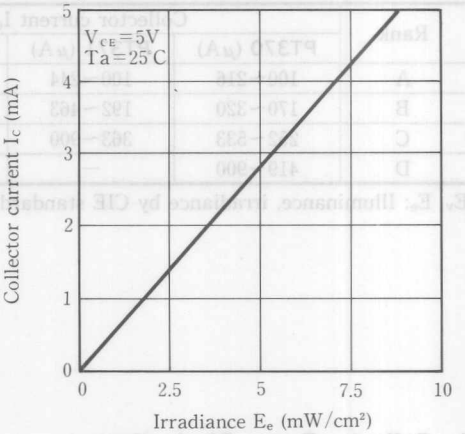


Fig. 7 Collector Current vs. Irradiance (PT372)

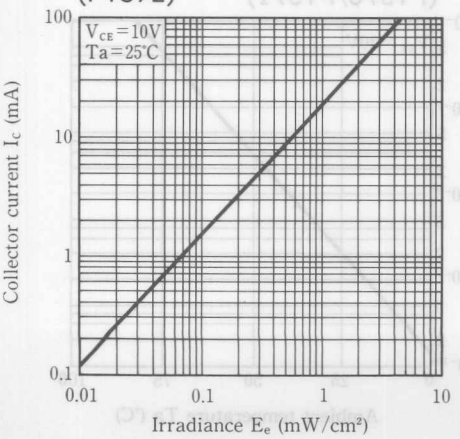


Fig. 8 Collector Current vs. Collector-emitter Voltage (PT370)

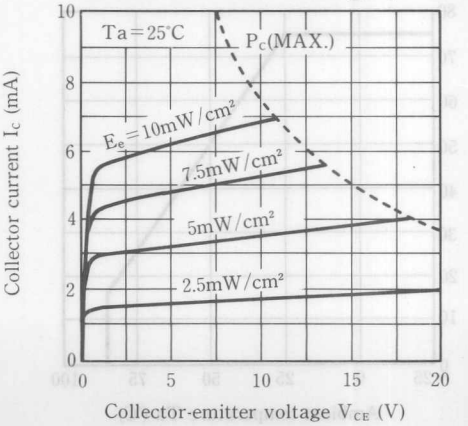


Fig. 9 Collector Current vs. Collector-emitter Voltage (PT371)

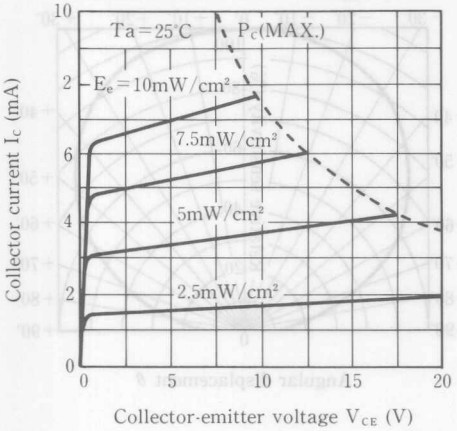


Fig. 10 Collector Current vs. Collector-emitter Voltage (PT372)

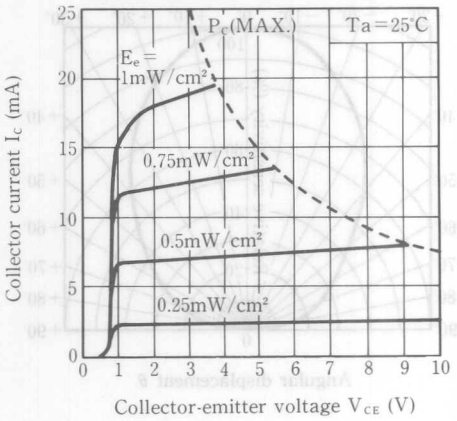


Fig. 11 Spectral Sensitivity

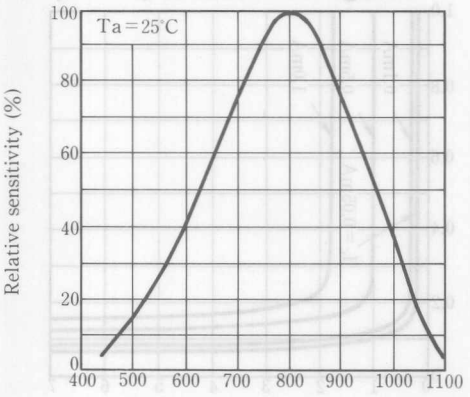


Fig. 12 Response Time vs. Load Resistance (PT370/PT371)

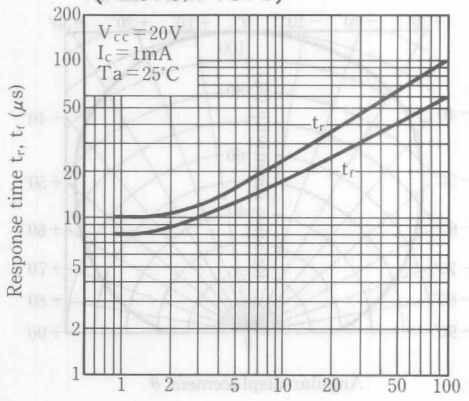
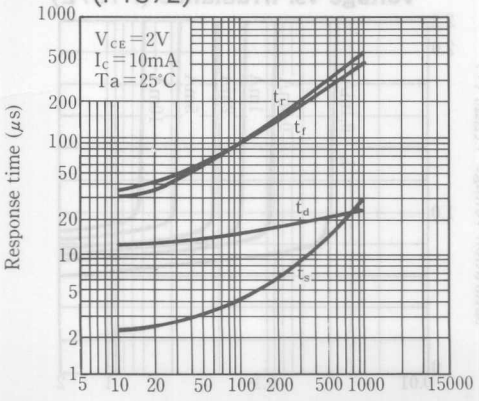
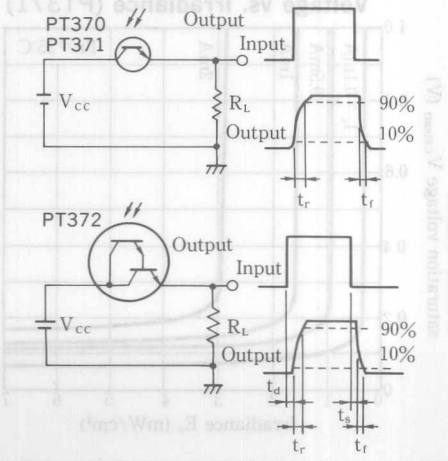


Fig. 13 Response Time vs. Load Resistance (PT372)



Test Circuit for Response Time



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Fig. 14 Sensitivity Diagram (PT370)
(Ta=25°C)

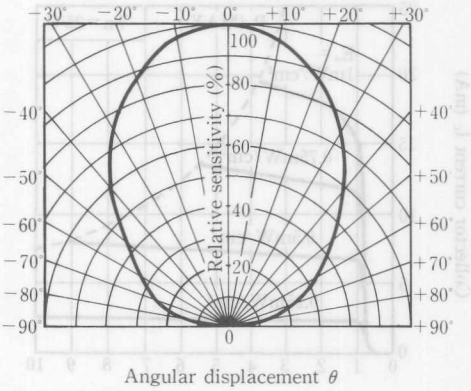


Fig. 15 Sensitivity Diagram (PT371)
(Ta=25°C)

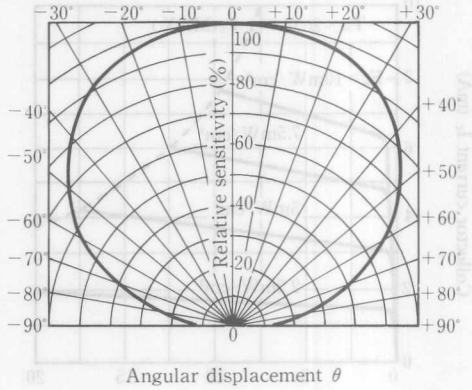


Fig. 16 Sensitivity Diagram (PT372)
(Ta=25°C)

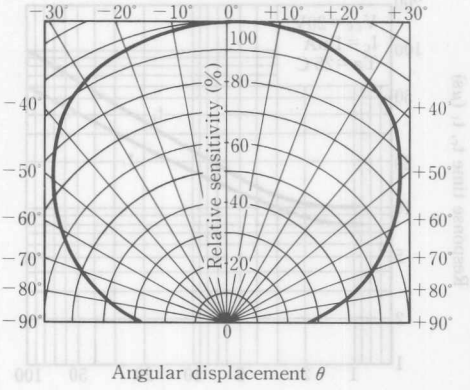


Fig. 17 Collector-emitter Saturation Voltage vs. Irradiance (PT370)

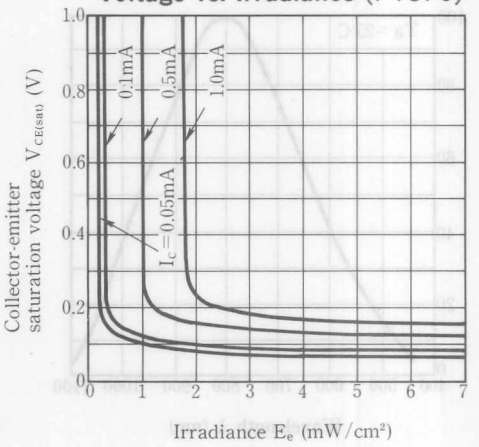


Fig. 18 Collector-emitter Saturation Voltage vs. Irradiance (PT371)

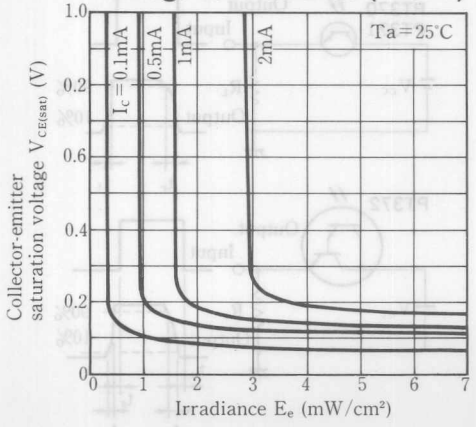
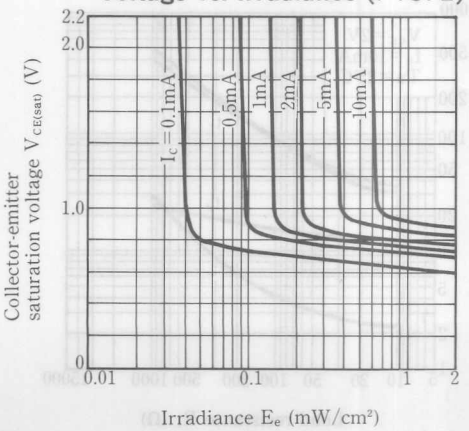


Fig. 19 Collector-emitter Saturation Voltage vs. Irradiance (PT372)



PT420F Intermediate Acceptance Phototransistor

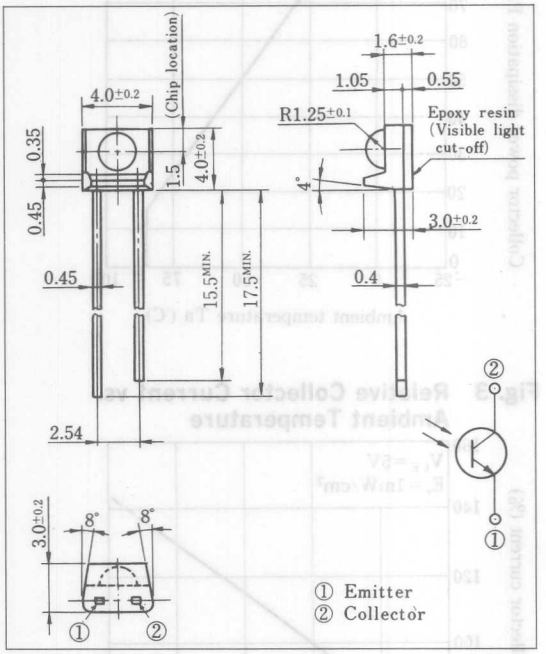
■ Features

1. Intermediate acceptance epoxy resin package ($\Delta\theta$: TYP. $\pm 40°$)
2. Visible light cut-off type

■ Applications

1. VCRs, cassette decks
2. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Emitter-collector voltage	V_{ECO}	6	V
Collector current	I_C	20	mA
Collector power dissipation	P_C	75	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 3 seconds at the position of 2.5mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Collector current	I_C	V_{CE}=5V, E_e=1mW/cm²	0.4	—	1.2	mA
Collector dark current	I_{CEO}	V_{CE}=20V, E_e=0	—	10^{-9}	10^{-7}	A
*2Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C=0.2mA, E_e=10mW/cm²	—	0.1	0.4	V
Peak sensitivity wavelength	λ_p	V_{CE}=2V, I_C=2mA, R_L=100Ω	760	860	960	nm
Response time (Rise)	t_r		—	8	15	μs
Response time (Fall)	t_f		—	10	20	μs
Half intensity angle	$\Delta\theta$		—	40	50	deg.

*2 E_e : Irradiance by CIE standard light source A (tungsten lamp)

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Fig. 1 Collector Power Dissipation vs. Ambient Temperature

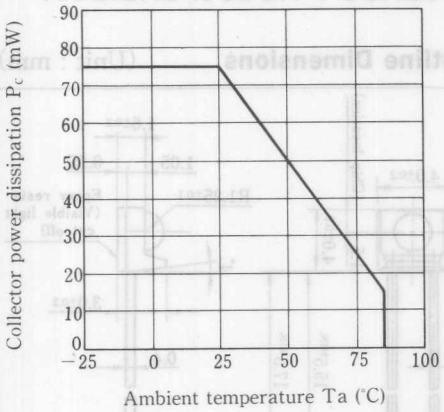


Fig. 2 Collector Dark Current vs. Ambient Temperature

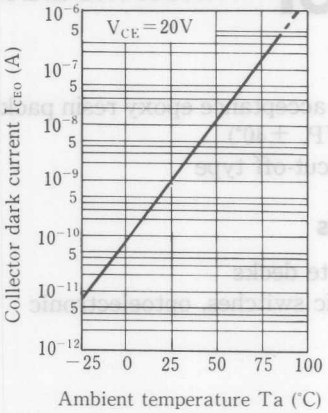


Fig. 3 Relative Collector Current vs. Ambient Temperature

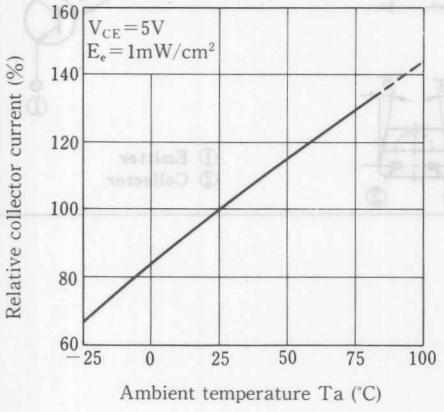


Fig. 4 Collector Current vs. Irradiance

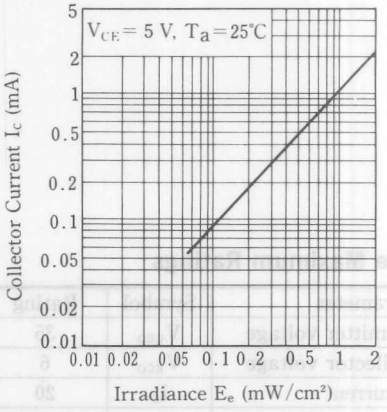


Fig. 5 Collector Current vs. Collector-emitter Voltage

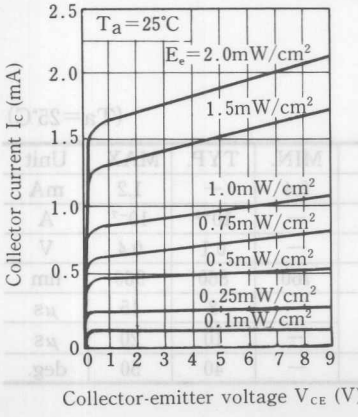


Fig. 6 Spectral Sensitivity

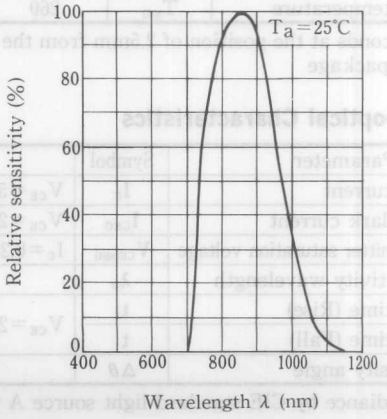
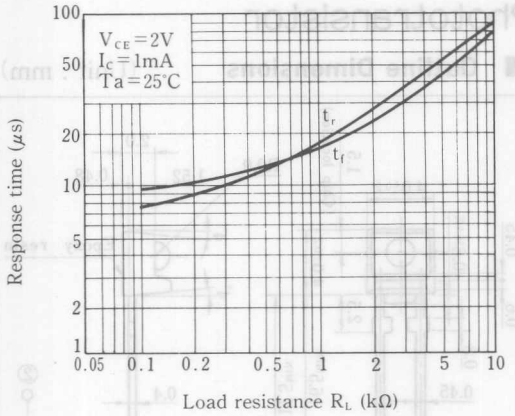


Fig. 7 Response Time vs. Load Resistance



Test Circuit for Response Time

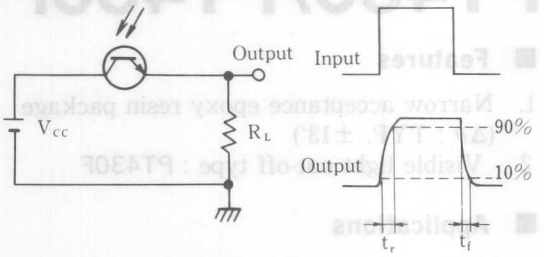


Fig. 8 Sensitivity Diagram (T_a=25°C)

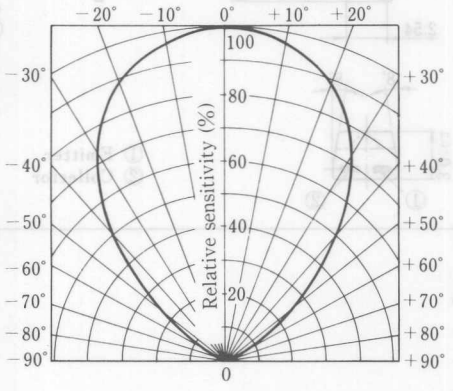
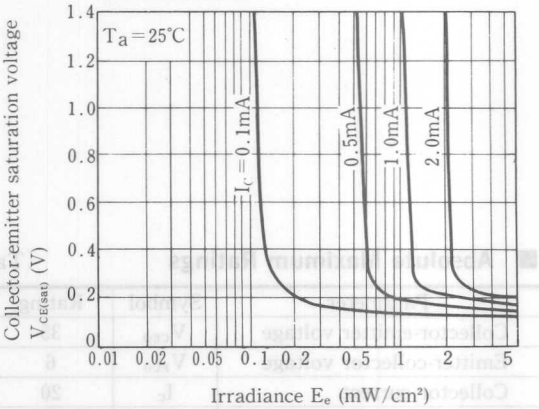


Fig. 9 Collector-emitter Saturation Voltage vs. Irradiance



5

PT430/PT430F Narrow Acceptance Phototransistor

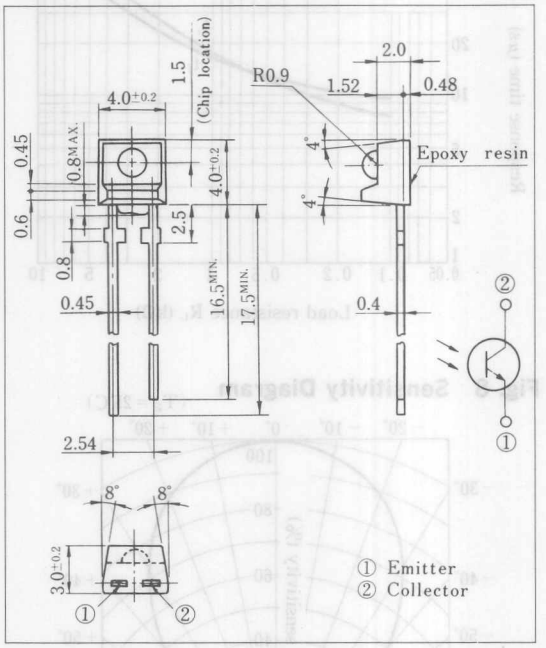
■ Features

1. Narrow acceptance epoxy resin package ($\Delta\theta$: TYP. ±13°)
2. Visible light cut-off type : PT430F

■ Applications

1. VCRs, cassete tape recorders
2. Optoelectronic switches, optoelectronic counters
3. Automatic stroboscopes

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Emitter-collector voltage	V_{ECO}	6	V
Collector current	I_C	20	mA
Collector power dissipation	P_C	75	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*1 Soldering temperature	T_{sol}	260	°C

*1 For 3 seconds at the position of 2.5mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2 Collector current	PT430	I_C	V_{CE}=5V	0.4	1.7	6.0	mA
	PT430F		E_e=1mW/cm²	0.25	0.8	3.0	mA
Collector dark current		I_{CEO}	V_{CE}=20V, E_e=0	—	10^{-9}	10^{-7}	A
*2 Collector-emitter saturation voltage		$V_{CE(sat)}$	I_C=0.5mA, E_e=10mW/cm²	—	0.1	0.4	V
Peak sensitivity wavelengh	PT430	λ_P		—	800	—	nm
	PT430F			—	860	—	nm
Response time (Rise)		t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	3	—	μs
Response time (Fall)		t_f		—	3.5	—	μs

*2 E_e : Irradiance by CIE standard light source A (tungsten lamp)

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

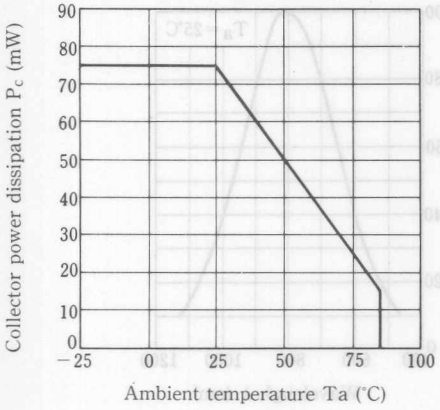


Fig. 2 Collector Dark Current vs. Ambient Temperature

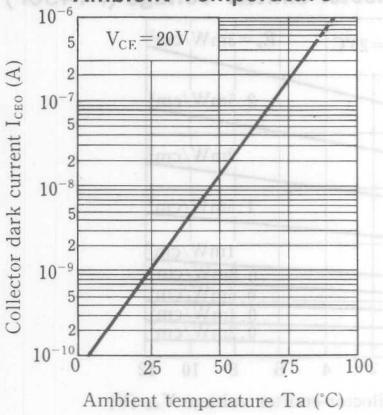


Fig. 3 Relative Collector Current vs. Ambient Temperature

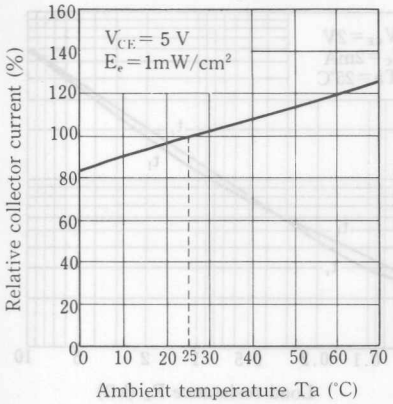


Fig. 4 Collector Current vs. Irradince (PT430)

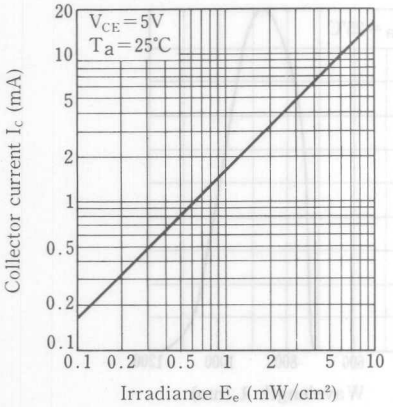


Fig. 5 Collector Current vs. Irradiance (PT430F)

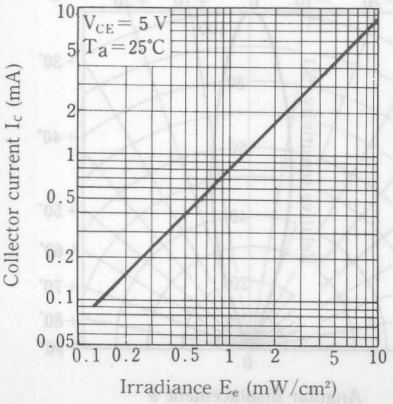
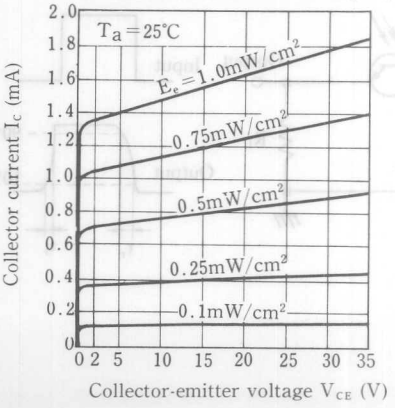


Fig. 6 Collector Current vs. Collector-emitter Voltage (PT430)



5

Fig. 7 Collector Current vs. Collector-emitter Voltage (PT430F)

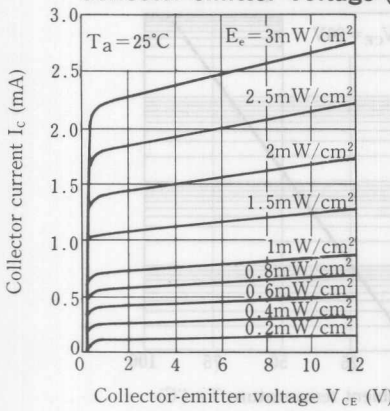


Fig. 8 Spectral Sensitivity (PT430)

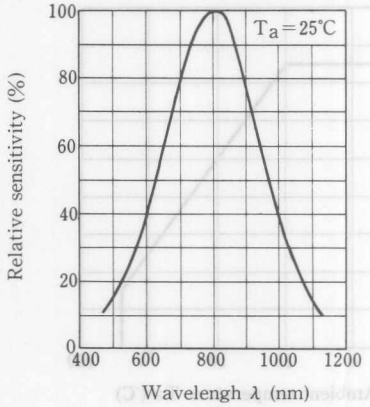


Fig. 9 Spectral Sensitivity (PT430F)

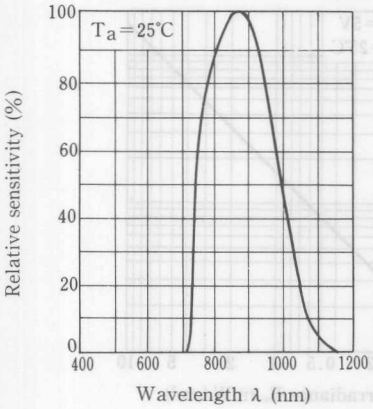
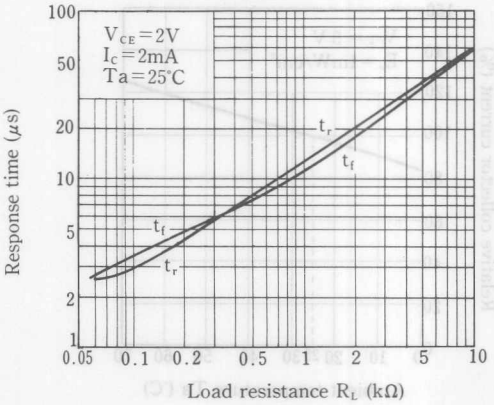


Fig. 10 Response Time vs. Load Resistance



Test Circuit for Response Time

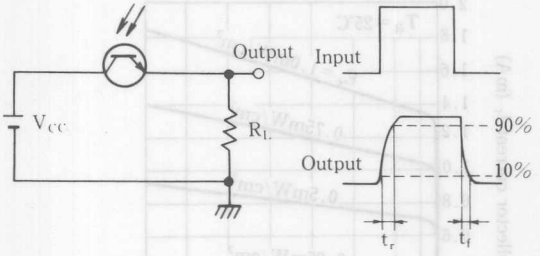


Fig. 11 Sensitivity Diagram

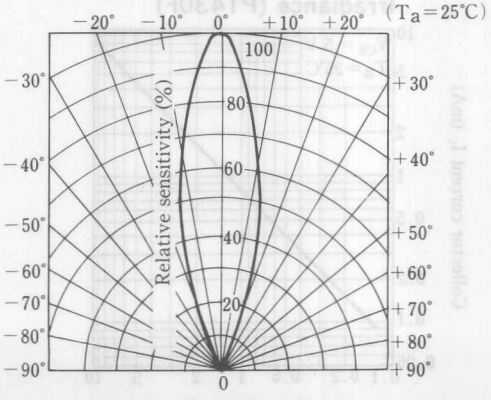


Fig. 12 Collector-emitter Saturation Voltage vs. Irradiance (PT430)

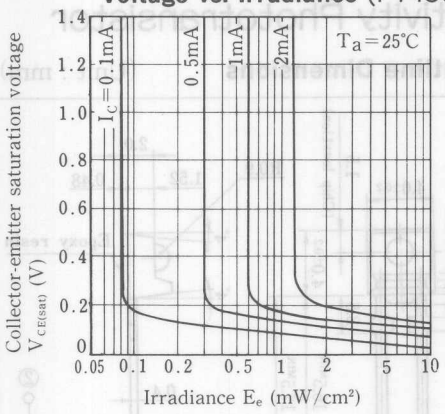


Fig. 13 Collector-emitter Saturation Voltage vs. Irradiance (PT430F)

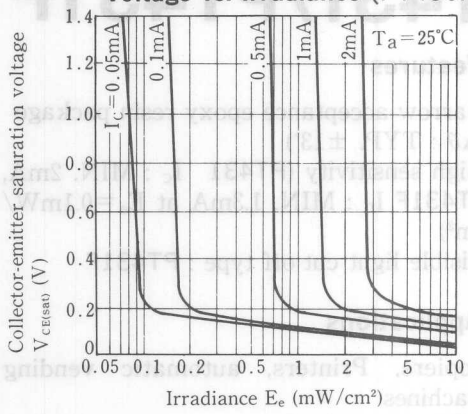


Fig. 14 Relative Output vs. Distance (Emitter : (GL430))

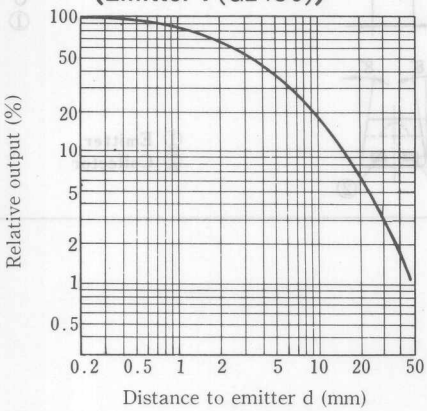
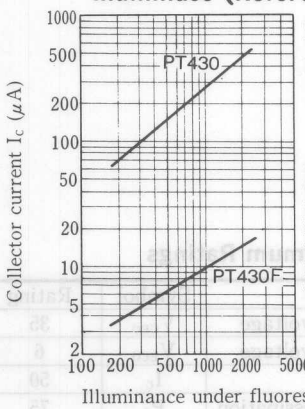


Fig. 15 Collector Current vs. Illuminace (Reference)



(Test Condition)
V_{CE}=2V, Ta=25°C
Light source :
White fluorescent lamp
Sharp FLR 40 SW/M

(Note)
Comparison between outputs of transparent resin molded type phototransistor (PT430) and visible light cut-off resin molded type (PT430F)

5

PT431/PT431F

Narrow Acceptance, High Sensitivity Phototransistor

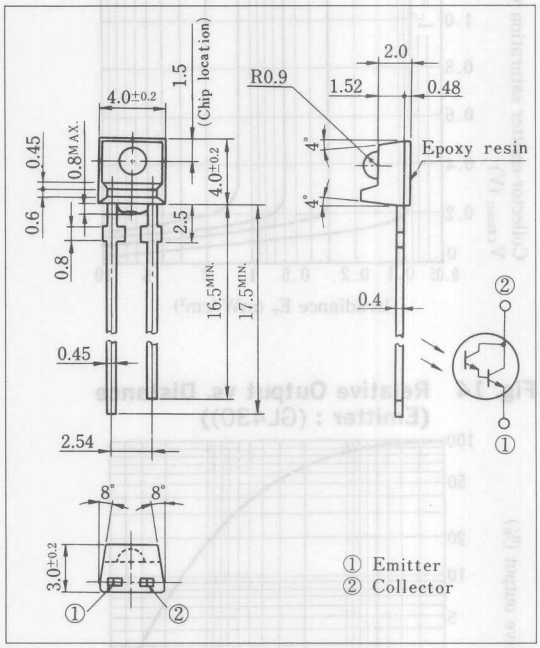
■ Features

1. Narrow acceptance epoxy resin package ($\Delta\theta$: TYP. ±13°)
2. High sensitivity (PT431 I_C : MIN. 2mA, PT431F I_C : MIN. 1.3mA at E_e=0.1mW/cm²)
3. Visible light cut-off type : PT431F

■ Applications

1. Copiers, Printers, automatic vending machines
2. VCRs, cassette decks
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Emitter-collector voltage	V_{ECO}	6	V
Collector current	I_C	50	mA
Collector power dissipation	P_C	75	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 3 seconds at the position of 2.5mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Collector current	PT431	I_C	V_{CE}=2V	2	—	—	mA
	PT431F		E_e=0.1mW/cm²	1.3	8.0	45	mA
Collector dark current		I_{CEO}	V_{CE}=10V, E_e=0	—	—	10^{-6}	A
*2Collector-emitter saturation voltage		$V_{CE(sat)}$	I_C=2.5mA, E_e=1mW/cm²	—	—	1.0	V
Peak sensitivity wavelength	PT431	λ_p		—	800	—	nm
	PT431F			—	860	—	nm
Response time (Rise)		t_r	V_{CE}=2V, I_C=10mA, R_L=100Ω	—	80	—	μs
Response time (Fall)		t_f		—	70	—	μs

*2 E_e : Irradiance by CIE standard light source A (tungsten lamp)

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

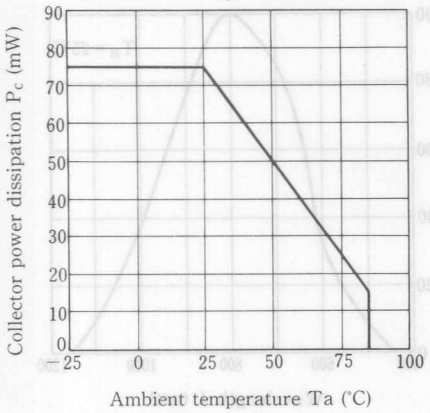


Fig. 2 Collector Dark Current vs. Ambient Temperature

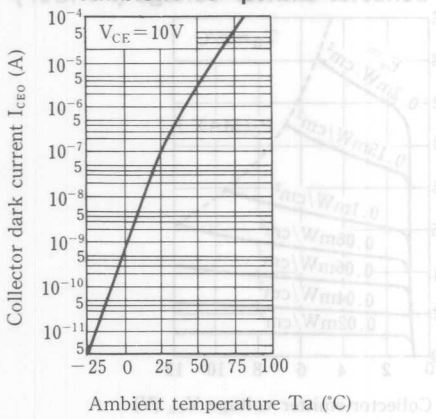


Fig. 3 Relative Collector Current vs. Ambient Temperature

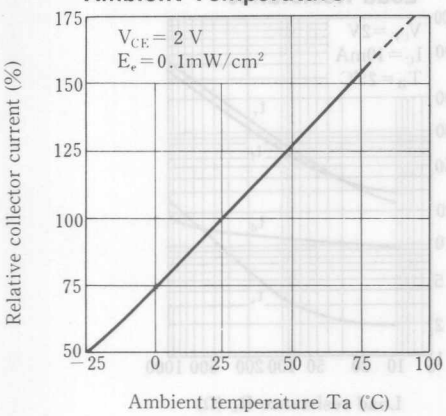


Fig. 4 Collector Current vs. Irradiance (PT431)

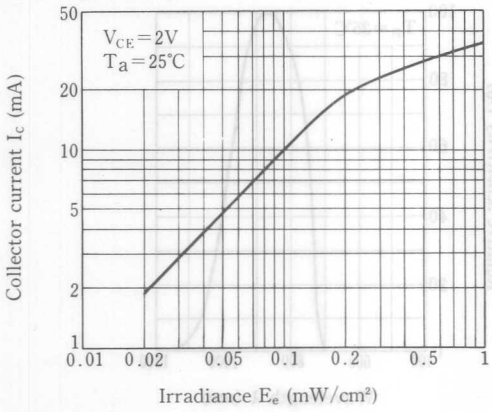


Fig. 5 Collector Current vs. Irradiance (PT431F)

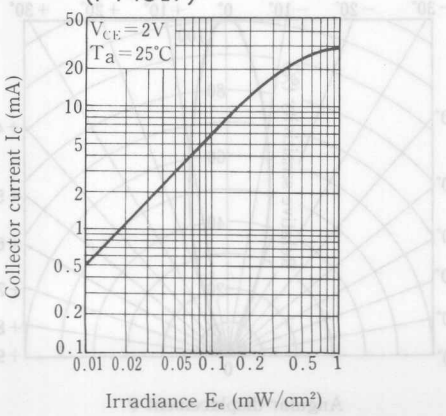
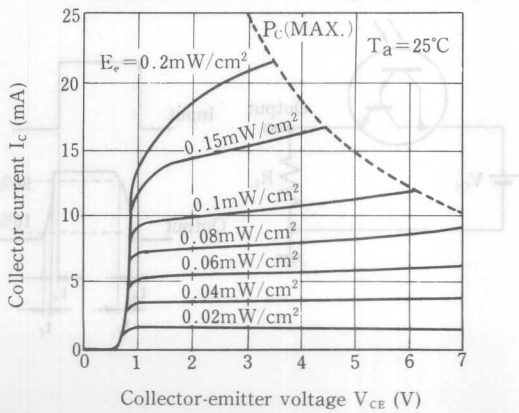


Fig. 6 Collector Current vs. Collector-emitter Voltage (PT431)



5

Fig. 7 Collector Current vs. Collector-emitter Voltage (PT431F)

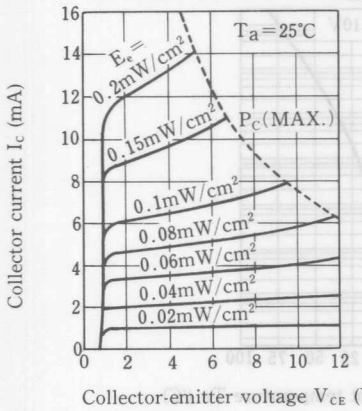


Fig. 8 Spectral Sensitivity (PT431)

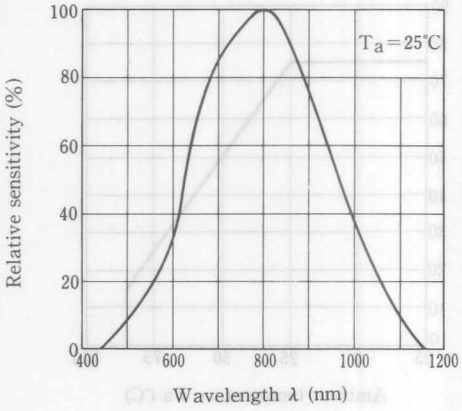


Fig. 9 Spectral Sensitivity (PT431F)

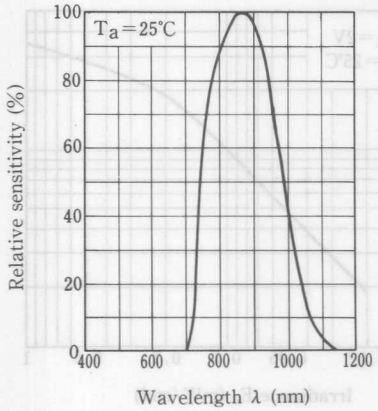
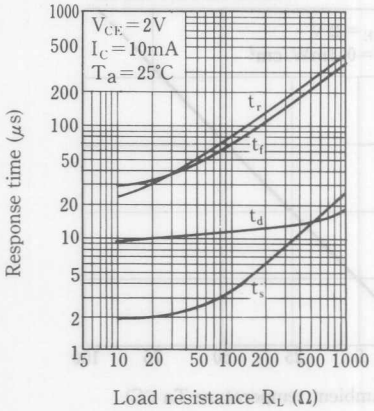


Fig. 10 Response Time vs. Load Resistance



Test Circuit for Response Time

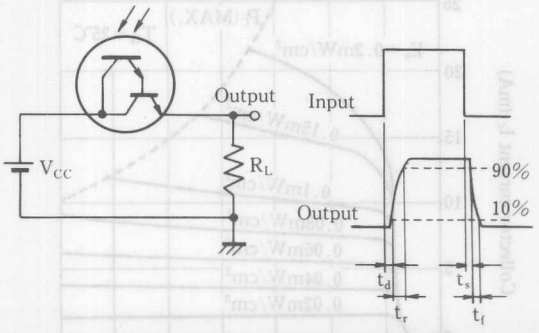
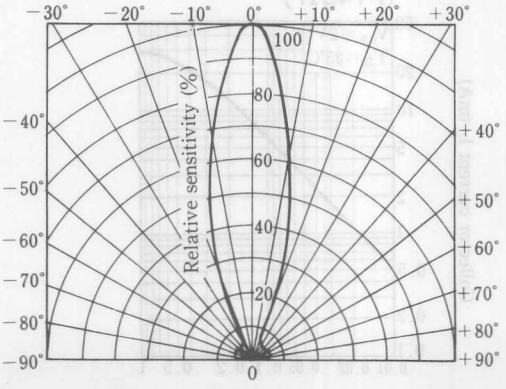
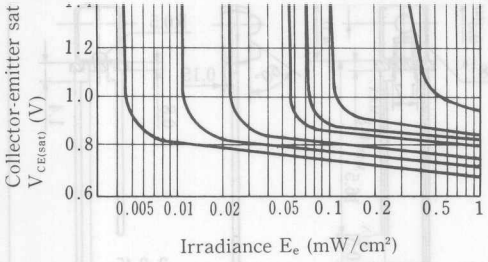


Fig. 11 Sensitivity Diagram (Ta=25°C)





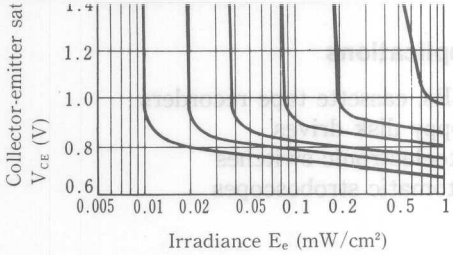


Fig. 14 Relative Output vs. Distance (Emitter : GL430)

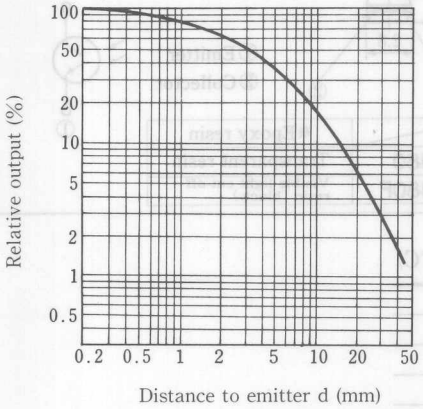
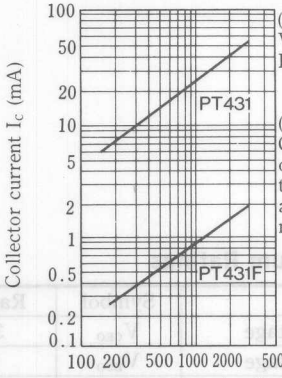


Fig. 15 Collector Current vs. Illuminance (Reference)



(Test Condition)
V_{CE}=2V Ta=25°C
Light source:
White fluorescent lamp
Sharp FLR-40 SW/M
(Note)
Comparison between outputs of transparent resin molded type phototransistor (PT431) and visible light cut-off resin molded type (PT431F)

5

PT480/PT480F

Narrow acceptance Phototransistor

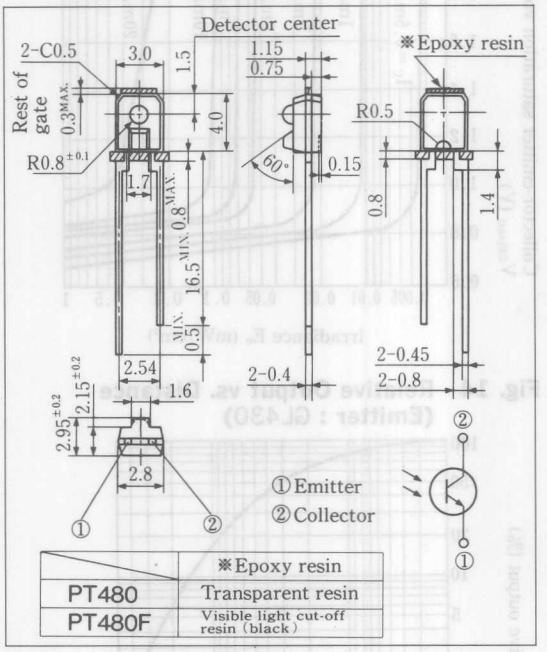
■ Features

1. Epoxy resin package
2. Narrow acceptance ($\Delta\theta$: TYP. $\pm 13°$)
3. Visible light cut-off type : PT480F

■ Applications

1. VCRs, cassette tape recorders
2. Floppy disk drives
3. Optoelectronic switches
4. Automatic stroboscopes

■ Outline Dimensions (Unit : mm)



	※Epoxy resin
PT480	Transparent resin
PT480F	Visible light cut-off resin (black)

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Emitter-collector voltage	V_{ECO}	6	V
Collector current	I_C	20	mA
Collector power dissipation	P_C	75	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 1.4mm from the bottom face of resin package

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Collector current	PT480	I_C	V_{CE}=5V	0.4	1.7	6.0	mA
	PT480F		E_e=1mW/cm²	0.25	0.8	3.0	mA
Collector dark current		I_{CEO}	V_{CE}=20V, E_e=0	—	10^{-9}	10^{-7}	A
*2Collector-emitter saturation voltage		$V_{CE(sat)}$	I_C=0.5mA, E_e=10mW/cm²	—	0.1	0.4	V
Peak sensitivity wavelength	PT480	λ_p		—	800	—	mm
	PT480F			—	860	—	nm
Response time (Rise)		t_r	V_{CE}=2V, I_C=2mA	—	3	—	μs
Response time (Fall)		t_f	R_L=100Ω	—	3.5	—	μs

*2 E_e : Irradiance by CIE standard light source A (tungsten lamp)

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

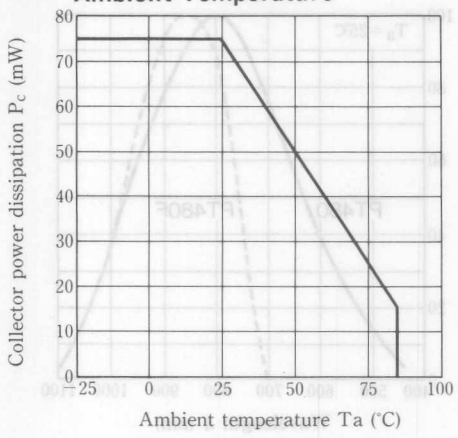


Fig. 2 Collector Dark Current vs. Ambient Temperature

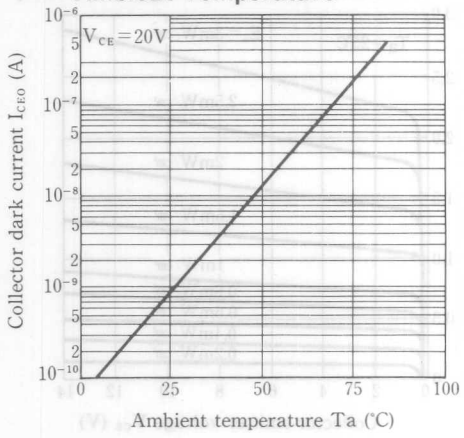


Fig. 3 Relative Collector Current vs. Ambient Temperature

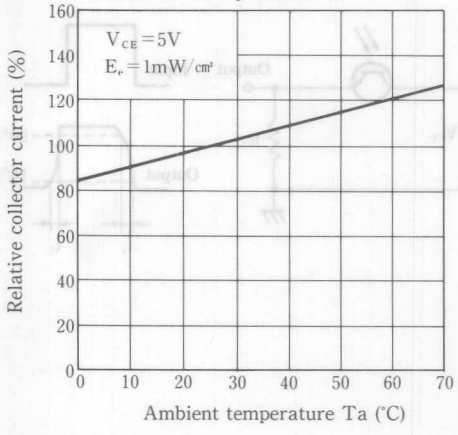


Fig. 4 Collector Current vs. Irradiance (PT480)

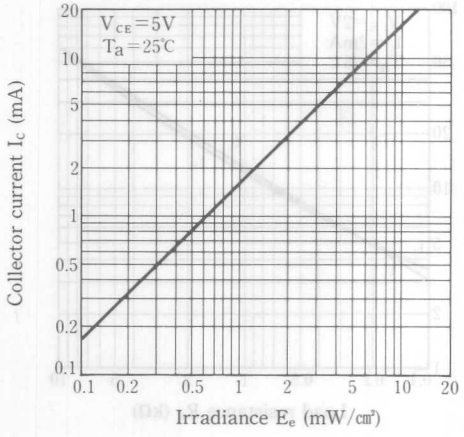


Fig. 5 Collector Current vs. Irradiance (PT480F)

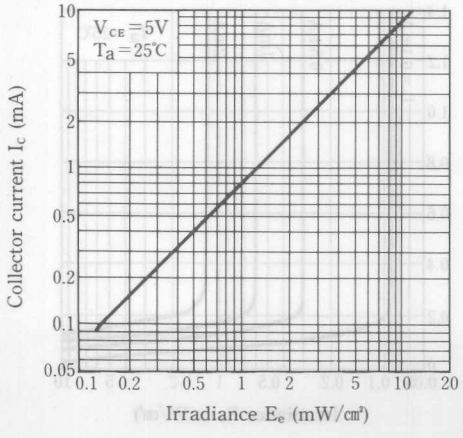
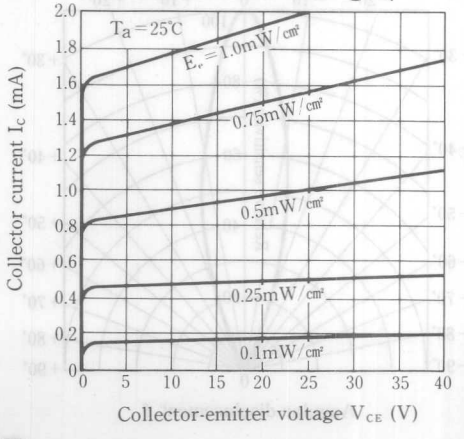


Fig. 6 Collector Current vs. Collector-emitter Voltage (PT480)



5

Fig. 7 Collector Current vs. Collector-emitter Voltage (PT480F)

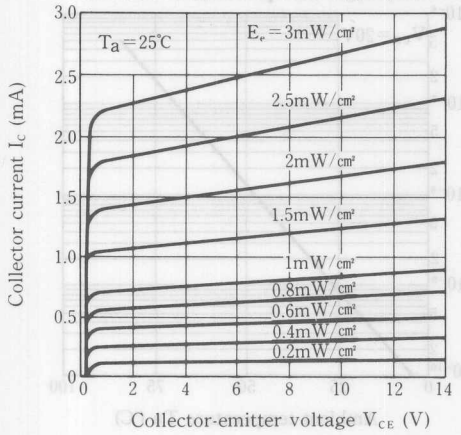


Fig. 8 Spectral Sensitivity

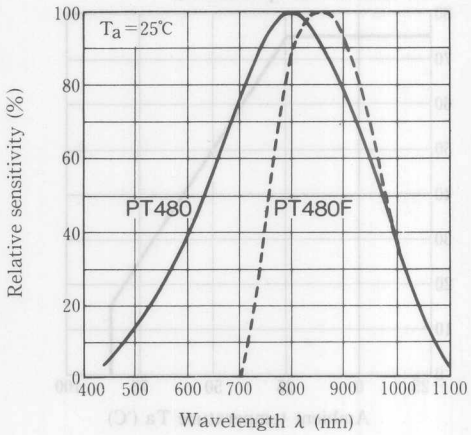
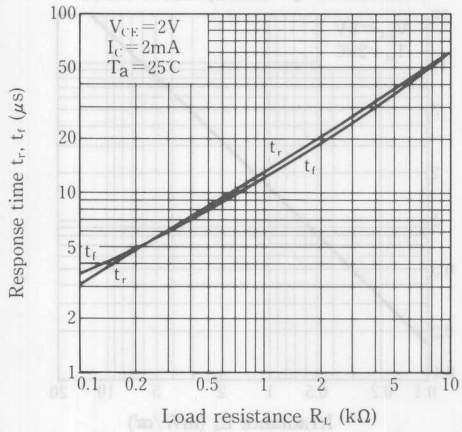


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

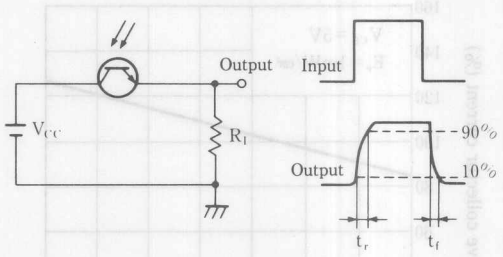


Fig. 10 Sensitivity Diagram

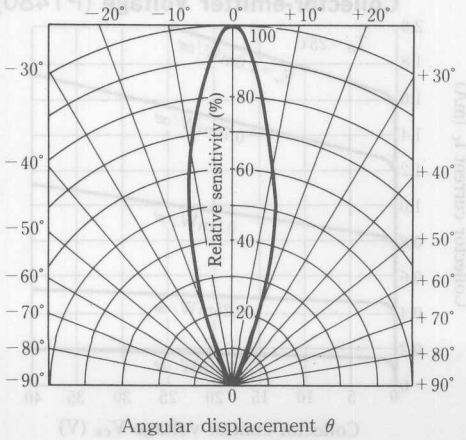


Fig. 11 Collector-emitter Saturation Voltage vs. Irradiance (PT480)

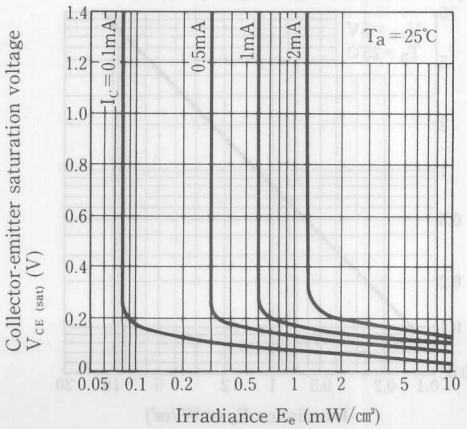


Fig. 12 Collector-emitter Saturation Voltage vs. Irradiance (PT480F)

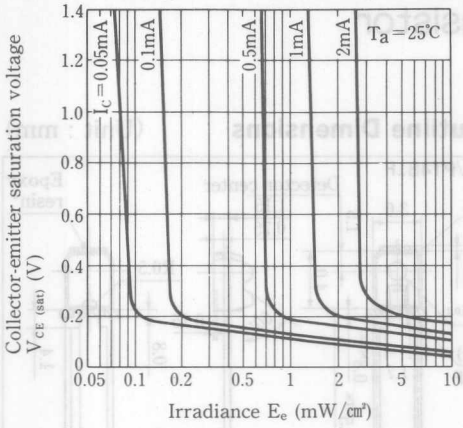
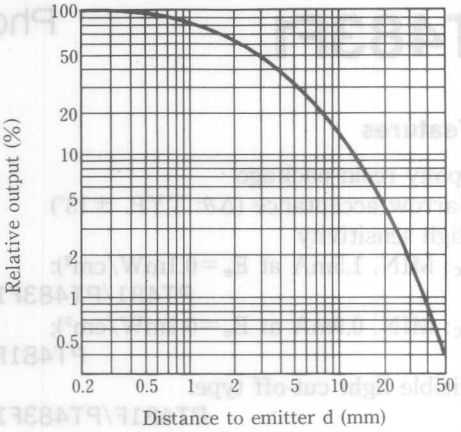


Fig. 13 Relative Output vs. Distance (Emitter : GL480)



5

PT481/PT481F/ PT483F1 Narrow Acceptance High Sensitivity Phototransistor

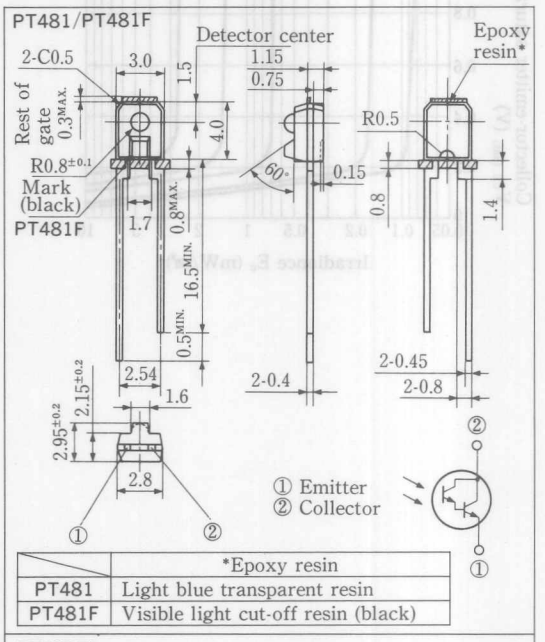
■ Features

1. Epoxy resin package
2. Narrow acceptance ($\Delta\theta$: TYP. ±13°)
3. High sensitivity
   (I_C: MIN. 1.5mA at E_e=0.1mW/cm²):
   PT481/PT483F1
   (I_C: MIN. 0.9mA at E_e=0.1mW/cm²);
   PT481F
4. Visible light cut-off type:
   PT481F/PT483F1
5. Long lead pin type: PT483F1

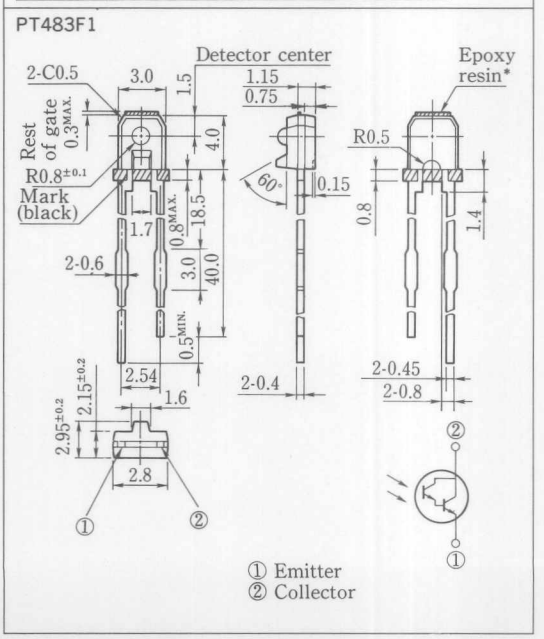
■ Applications

1. VCRs, cassette tape recorders
2. Floppy disk drives
3. Optoelectronic switches
4. Automatic stroboscopes

■ Outline Dimensions (Unit : mm)



	*Epoxy resin
PT481	Light blue transparent resin
PT481F	Visible light cut-off resin (black)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Emitter-collector voltage	V_{ECO}	6	V
Collector current	I_C	50	mA
Collector power dissipation	P_C	75	mW
Operating temperature	T_{opr}	−25~+85	°C
Storage temperature	T_{stg}	−40~+85	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 1.4mm from the bottom face of resin package

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Collector current	PT481	I_C	V_{CE}=2V, E_e=0.1mW/cm²	1.5	10	25	mA
	PT481F			0.9	—	27	mA
	PT483F1			1.5	—	4.0	mA
Collector dark current		I_{CEO}	V_{CE}=10V, E_e=0	—	—	10^{-6}	A
*2Collector-emitter saturation voltage		$V_{CE(sat)}$	I_C=1.5mA (PT481: I_C=2.5mA), E_e=1mW/cm²	—	0.7	1.0	V
Peak emission wavelength	PT481	λ_p		—	800	—	nm
	PT481F/PT483F1			—	860	—	nm
Response time (Rise)		t_r	V_{CE}=2V, I_C=10mA	—	80	—	μs
Response time (Fall)		t_f	R_L=100Ω	—	70	—	μs

*2 E_e: Irradiance by CIE standard light source A (tungsten lamp)

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

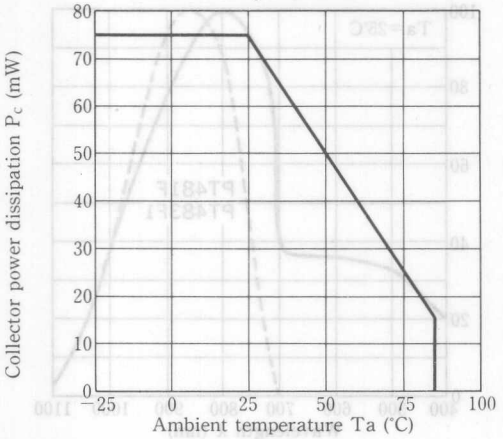


Fig. 2 Collector Dark Current vs. Ambient Temperature

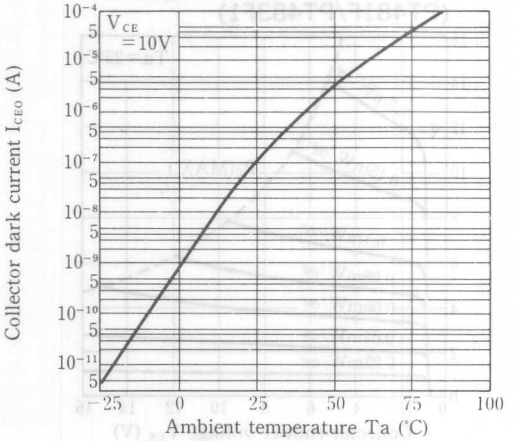


Fig. 3 Relative Collector Current vs. Ambient Temperature

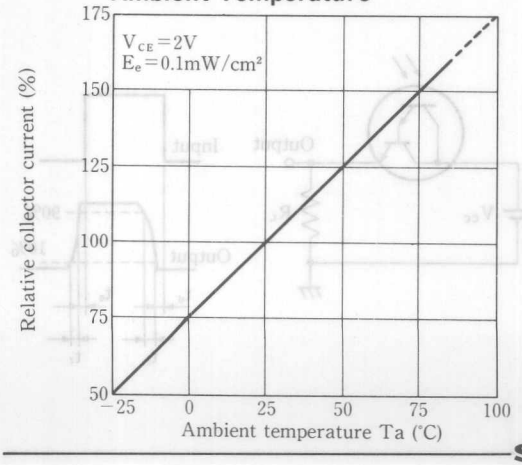
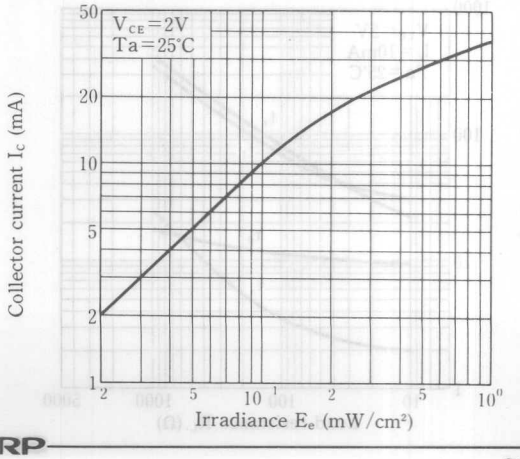


Fig. 4 Collector Current vs. Irradiance (PT481)



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Fig. 5 Collector Current vs. Irradiance (PT481F/PT483F1)

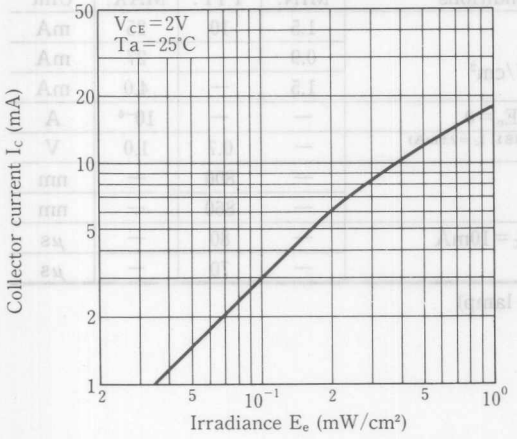


Fig. 6 Collector Current vs. Collector-emitter Voltage (PT481)

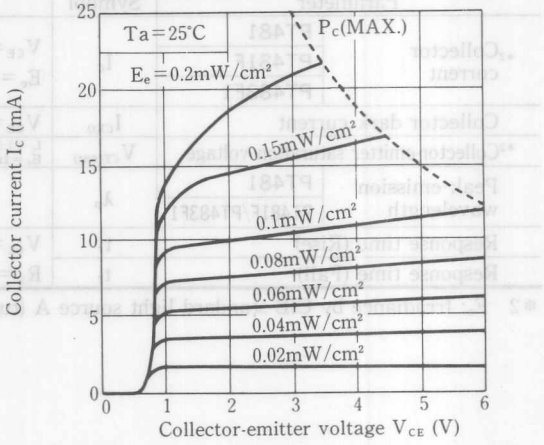


Fig. 7 Collector Current vs. Collector-emitter Voltage (PT481F/PT483F1)

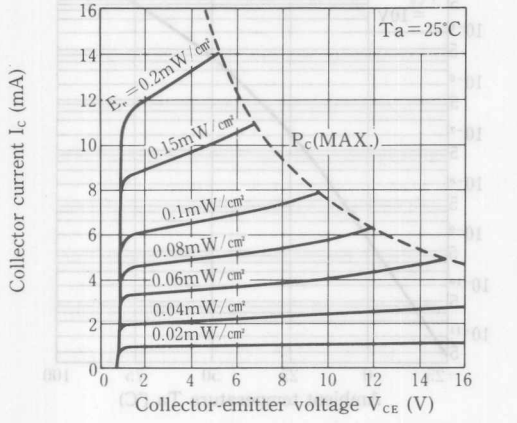


Fig. 8 Spectral Sensitivity

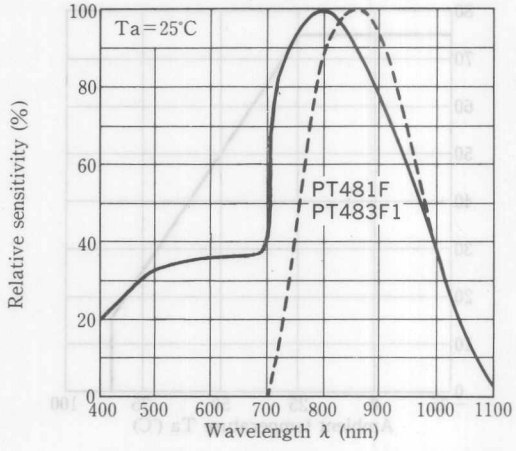
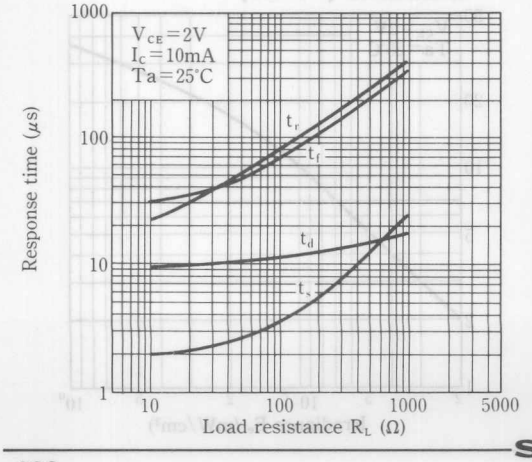


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

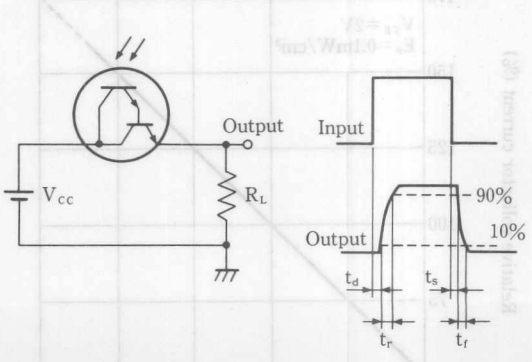


Fig. 10 Sensitivity Diagram (Ta=25°C)

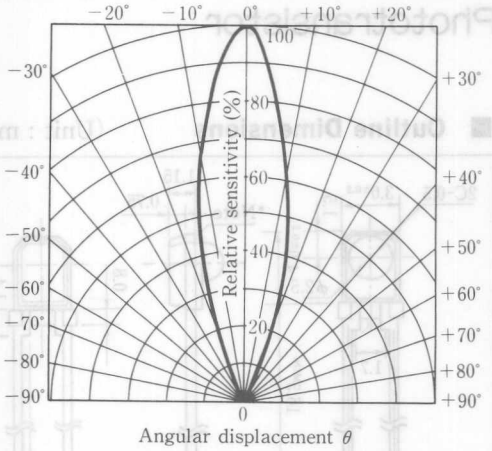


Fig. 11 Collector-emitter Saturation Voltage vs. Irradiance (PT481) (Ta=25°C)

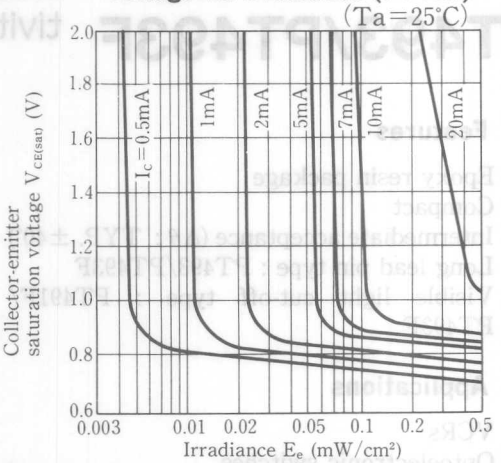


Fig. 12 Collector-emitter Saturation Voltage vs. Irradiance (PT481F/PT483F1) (Ta=25°C)

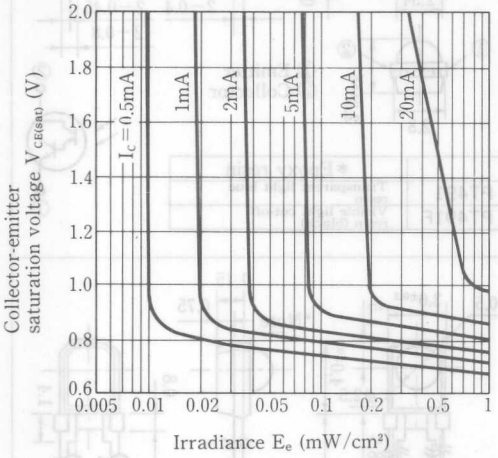
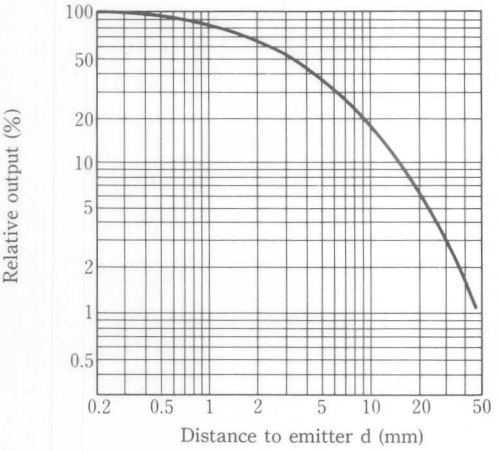


Fig. 13 Relative Output vs. Distance (PT481F/PT483F1) **(Emitter:** GL480)



5

PT491/PT491F PT493/PT493F

Intermediate Acceptance High Sensitivity Phototransistor

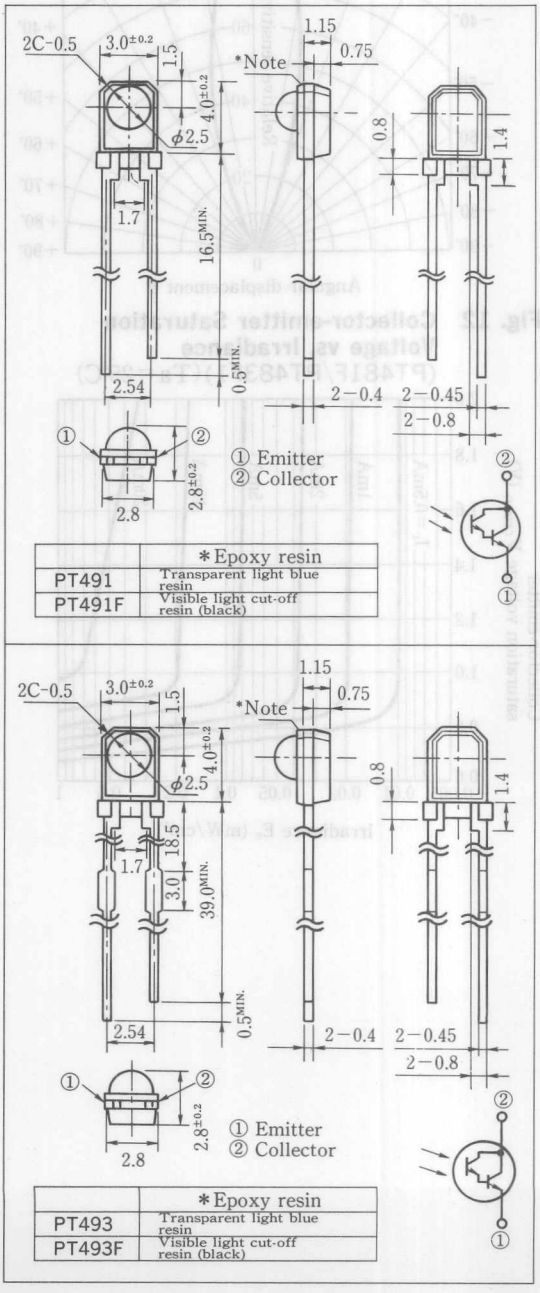
■ Features

1. Epoxy resin package
2. Compact
3. Intermediate acceptance ($\Delta\theta$: TYP. $\pm 40°$)
4. Long lead pin type : PT493/PT493F
5. Visible light cut-off type : PT491F/PT493F

■ Applications

1. VCRs
2. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



	*Epoxy resin
PT491	Transparent light blue resin
PT491F	Visible light cut-off resin (black)

	*Epoxy resin
PT493	Transparent light blue resin
PT493F	Visible light cut-off resin (black)

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Emitter-collector voltage	V_{ECO}	6	V
Collector current	I_C	50	mA
Collector power dissipation	P_C	75	mW
Operating temperature	T_{opr}	−25～+85	°C
Storage temperature	T_{stg}	−40～+85	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 3 seconds at the position of 1.4mm from the surface of resin edge

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Collector current	PT491/PT493	I_C	V_{CE}=2V, E_v=2ℓx	0.3	0.6	1.3	mA
	PT491F/PT493F			0.2	0.4	0.8	mA
Collector dark current		I_{CEO}	V_{CE}=10V, E_e=0	—	—	10^{-6}	A
*2 Collector-emitter saturation voltage		$V_{CE(sat)}$	I_C=0.8mA, E_e=1mW/cm²	—	—	1.0	V
Peak sensitivity wavelength	PT491/PT493	λ_p		—	800	—	nm
	PT491F/PT493F			—	860	—	nm
Response time (Rise)		t_r	V_{CE}=2V, I_C=5mA, R_L=100Ω	—	80	400	μs
Response time (Fall)		t_f		—	70	350	μs
Half intensity angle		Δθ		—	±40	—	deg.

*2 E_e, E_v : Illuminance, irradiance by CIE standard light source A (tungsten lamp)

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

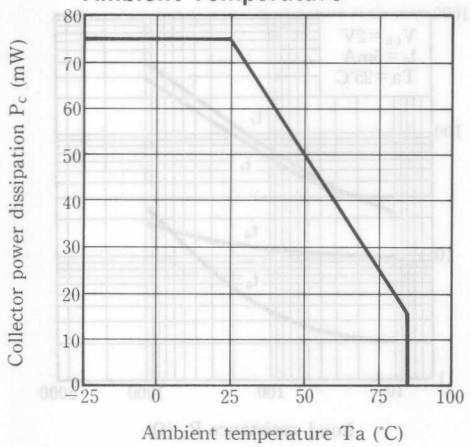


Fig. 2 Collector Dark Current vs. Ambient Temperature

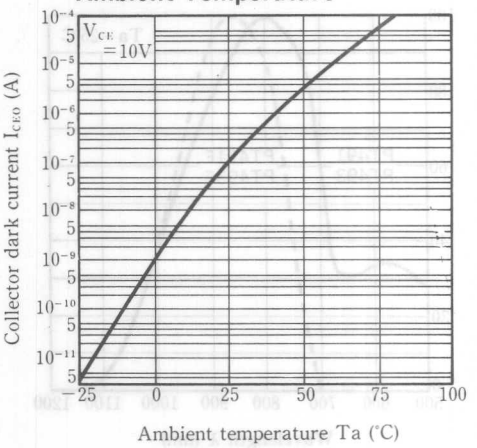


Fig. 3 Relative Collector Current vs. Ambient Temperature

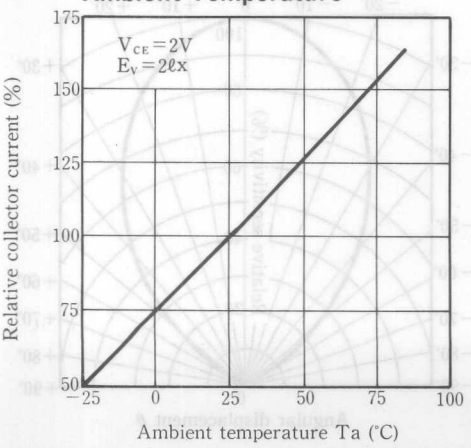
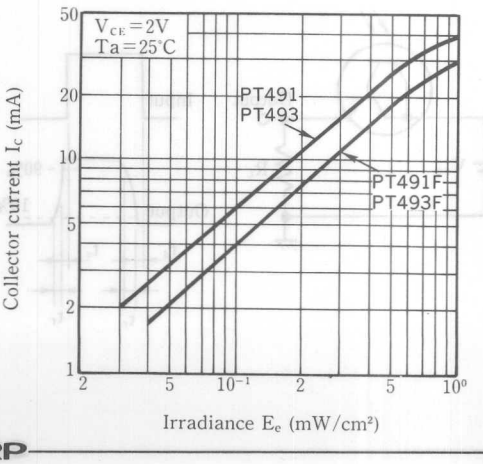


Fig. 4 Collector Current vs. Irradiance



5

Fig. 5 Collector Current vs. Collector-emitter Voltage (PT491/PT493)

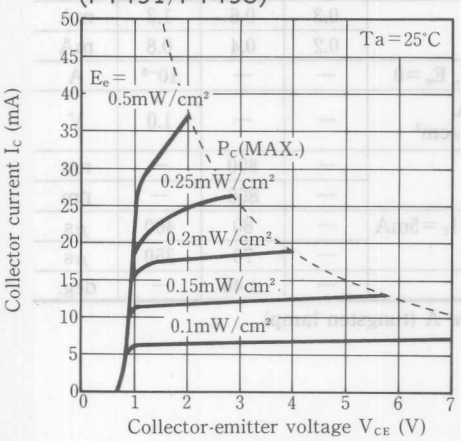


Fig. 6 Collector Current vs. Collector-emitter Voltage (PT491F/PT493F)

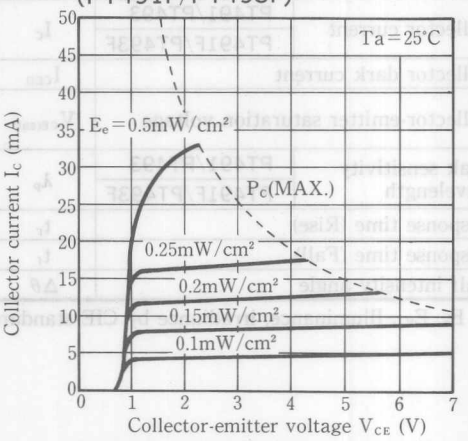


Fig. 7 Spectral Sensitivity

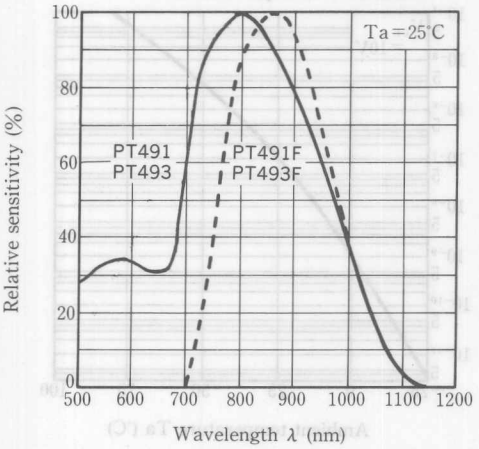
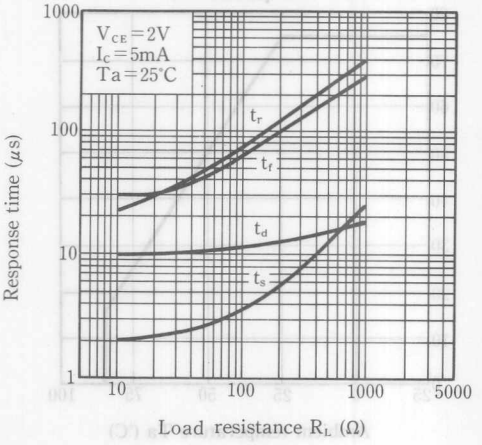


Fig. 8 Response Time vs. Load Resistance



Test Circuit for Response Time

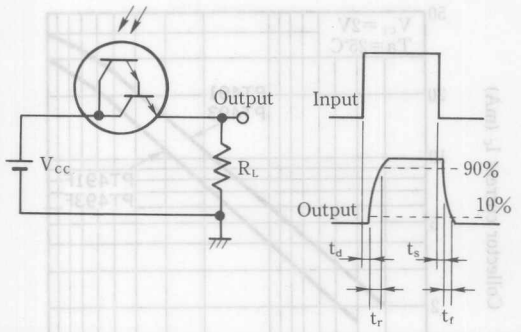


Fig. 9 Sensitivity Diagram (Ta=25°C)

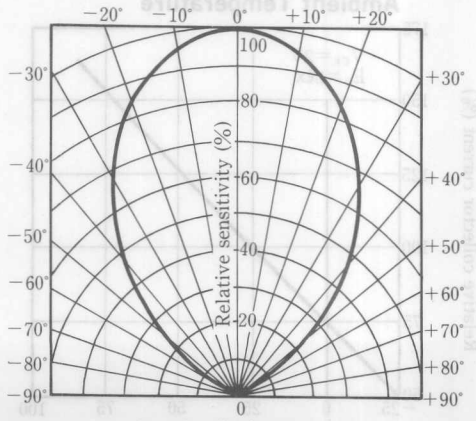


Fig. 10 Collector-emitter Saturation Voltage vs. Irradiance (PT491/PT493)

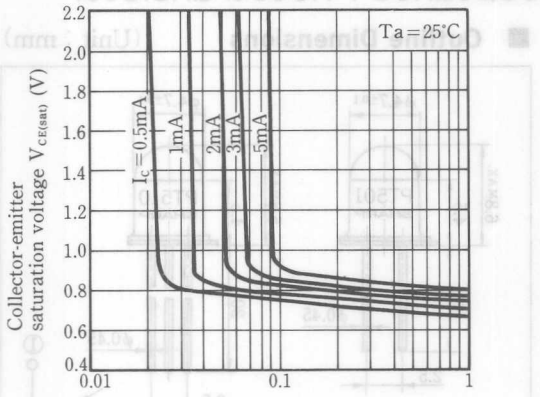
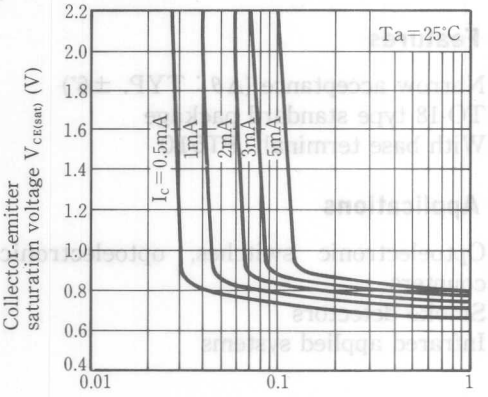


Fig. 11 Collector-emitter Saturation Voltage vs. Irradiance (PT491F/PT493F)



5

PT501/PT510 TO-18 Type Narrow Acceptance Phototransistor

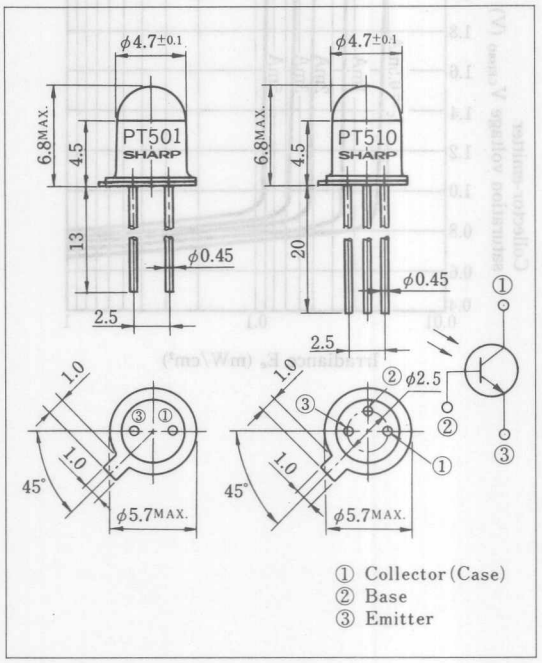
■ Features

1. Narrow acceptance ($\Delta\theta$: TYP. $\pm 6°$)
2. TO-18 type standard package
3. With base terminal : PT510

■ Applications

1. Optoelectronic switches, optoelectronic counters
2. Smoke detectors
3. Infrared applied systems

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	PT501	PT510	Unit
Collector-emitter voltage	V_{CEO}	45	35	V
Emitter-collector voltage	V_{ECO}	6	6	V
Collector-base voltage	V_{CBO}	—	35	V
Emitter-base voltage	V_{EBO}	—	6	V
Collector power dissipation	P_C	75	75	mW
Operating temperature	T_{opr}	−25～+125	−25～+125	°C
Storage temperature	T_{stg}	−55～+150	−55～+150	°C
*1Soldering temperature	T_{sol}	260	260	°C

*1 For 10 seconds at the position of 1.3mm from the bottom face of can package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.		MAX.	Unit
*2Collector current	I_C	V_{CE}=5V, E_e=10mW/cm²	2.5	PT501	10	—	mA
				PT510	20		
Collector dark current	I_{CEO}	V_{CE}=30V, E_e=0	—	2×10^{-9}		10^{-7}	A
*2Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C=1mA, E_e=10mW/cm²	—	0.2		—	V
Peak sensitivity wavelength	λ_p		—	800		—	nm
Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω (PT501 : 1kΩ)	—	PT501	10	—	μs
				PT510	2		
Response time (Fall)	t_f		—	PT501	10	—	μs
				PT510	3		

*2 E_e : Irradiance by CIE standard light source A (tungsten lamp)

※2 Classification Table of Collector Current (I_C)

Model No.	I_C (mA)
PT501A	20~80
PT501B	10~25
PT501C	2.5~15

at V_{CE}=5V, E_e=10mW/cm², Ta=25°C

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

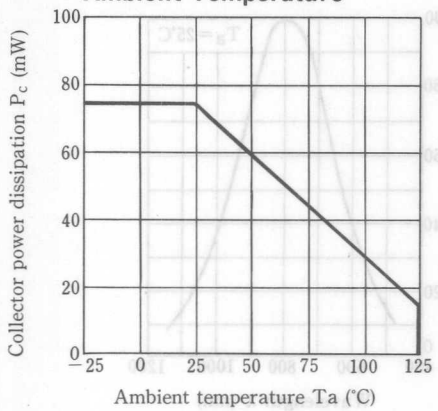


Fig. 2 Collector Dark Current vs. Ambient Temperature

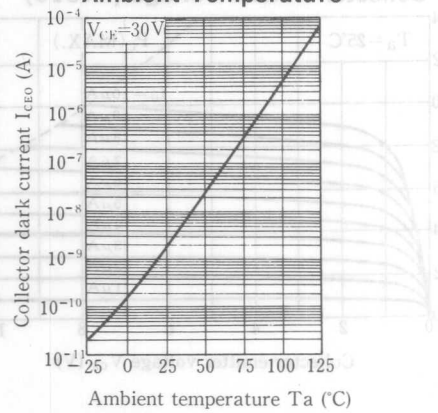
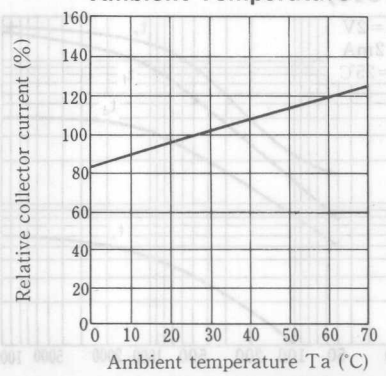
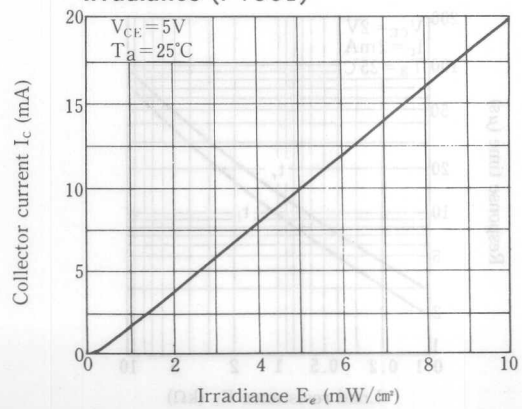


Fig. 3 Relative Collector Current vs. Ambient Temperature



(PT550 : V_{CE}=5V, E_e=0.1mW/cm²
PT550F : V_{CE}=5V, E_e=1mW/cm²)

Fig. 4 Collector Current vs. Irradiance (PT501)



5

Fig. 5 Collector Current vs. Irradiance (PT510)

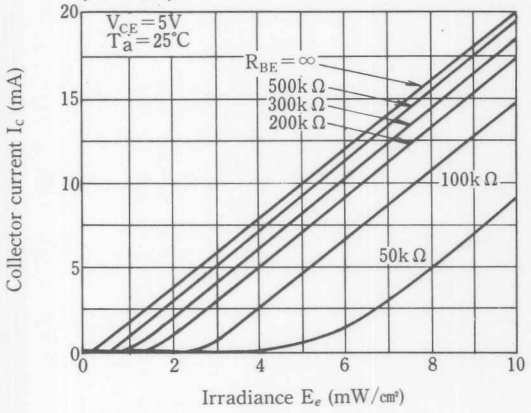


Fig. 6 Collector Current vs. Collector-emitter Voltage (PT501)

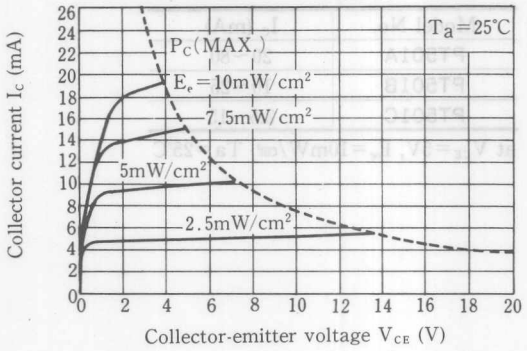


Fig. 7 Collector Current vs. Collector-emitter Voltage (PT510)

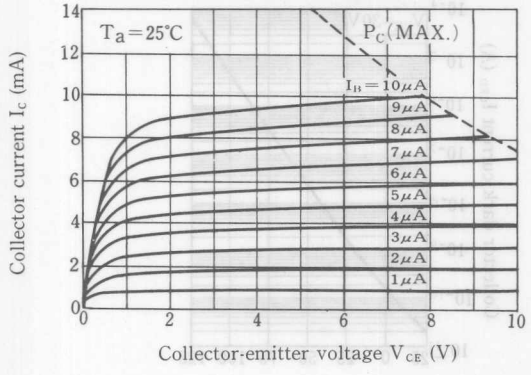


Fig. 8 Spectral Sensitivity

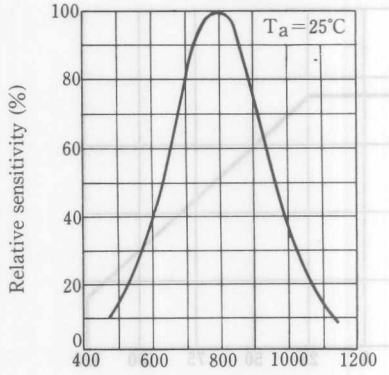


Fig. 9 Response Time vs. Load Resistance

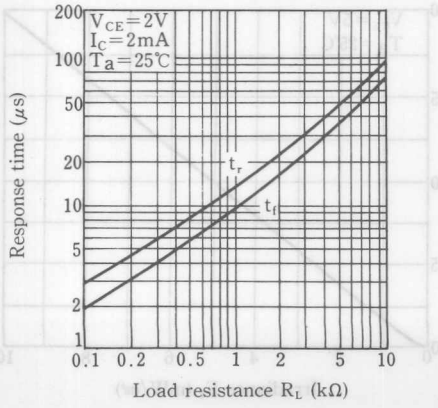
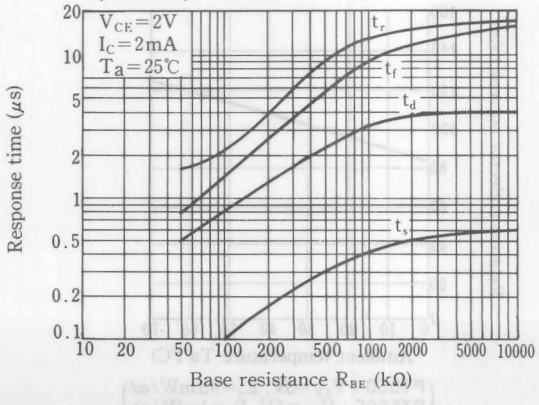
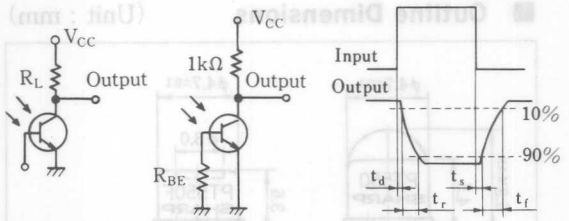


Fig. 10 Response Time vs. Base Resistance (PT510)



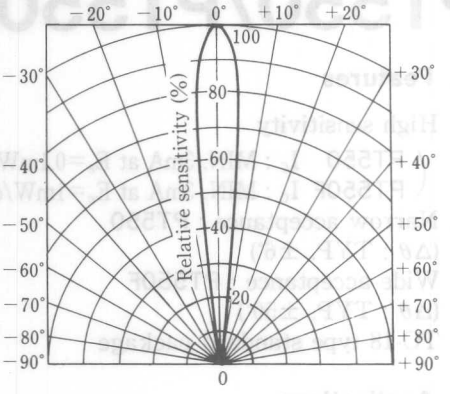
Test Circuit for Response Time

Correspond to Fig.9 Correspond to Fig.10



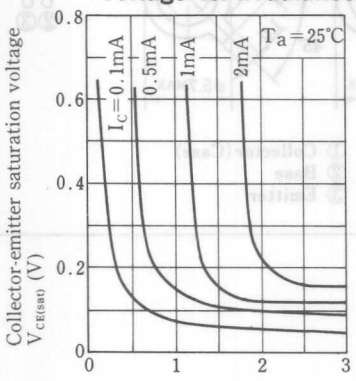
(PT501 has no base terminal.)

Fig. 11 Sensitivity Diagram



Angular displacement θ

Fig. 12 Collector-emitter Saturation Voltage vs. Irradiance



Irradiance E_e (mW/cm²)

5

PT550/PT550F

TO-18 Type Phototransistor with Base Terminal

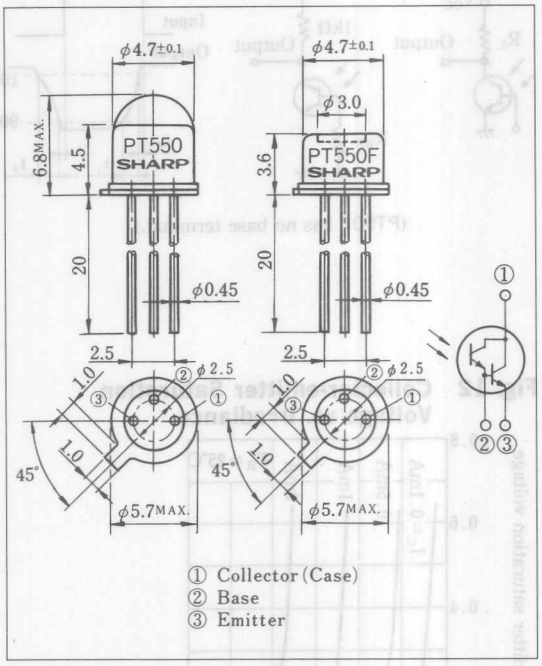
■ Features

1. High sensitivity
   (PT550 I_C : MIN. 3mA at E_e=0.1mW/cm²
   PT550F I_C : MIN. 3mA at E_e=1mW/cm²)
2. Narrow acceptance : PT550
   ($\Delta\theta$: TYP. ±6°)
   Wide acceptance : PT550F
   ($\Delta\theta$: TYP. ±50°)
3. TO-18 type standard package

■ Applications

1. Optoelectronic switches, optoelectronic counters
2. Smoke detectors
3. Infrared applied systems

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CEO}	35	V
Collector-base voltage	V_{CBO}	35	V
Emitter-base voltage	V_{EBO}	6	V
Collector current	I_C	100	mA
Collector power dissipation	P_C	150	mW
Operating temperature	T_{opr}	−25～+125	°C
Storage temperature	T_{stg}	−55～+150	°C
*1Soldering temperature	T_{sol}	260	°C

*1 For 10 seconds at the position of 1.3mm from the bottom face of can package

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions PT550	Conditions PT550F	MIN.	TYP.	MAX.	Unit
*2Collector current	I_C	V_{CE}=5V, E_e=0.1mW/cm²	V_{CE}=5V, E_e=1mW/cm²	3	20	—	mA
Collector dark current	I_{CEO}	V_{CE}=10V, E_e=0, I_B=0		—	10^{-7}	10^{-6}	A
Collecter-emitter saturation voltage	$V_{CE(sat)}$	I_C=1mA, E_e=0.1mW/cm²	I_C=1mA, E_e=1mW/cm²	—	—	1.0	V
Peak sensitivity wavelength	λ_p			—	800	—	nm
Response time (Rise)	t_r	V_{CC}=15V, R_L=1kΩ		—	350	—	μs
Response time (Fall)	t_f			—	300	—	μs

*2 E_e : Irradiance by CIE standard light source A (tungsten lamp)

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

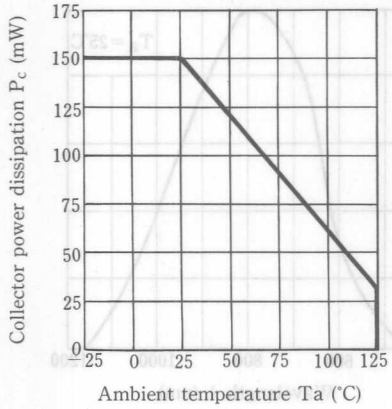


Fig. 2 Collector Dark Current vs. Ambient Temperature

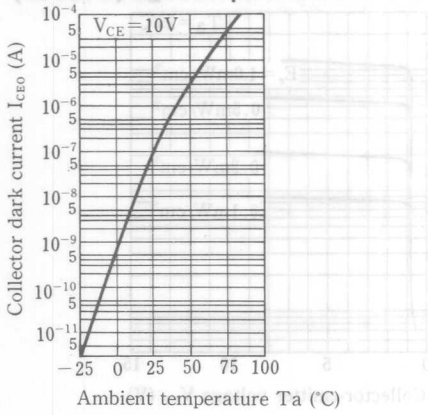


Fig. 3 Relative Collector Current vs. Ambient Temperature

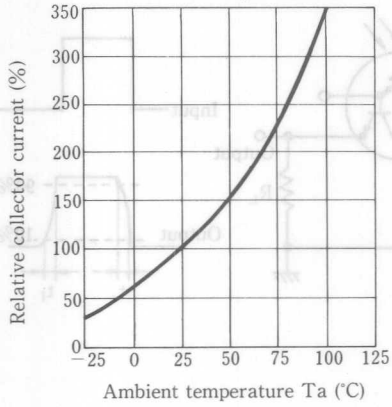


Fig. 4 Collector Current vs. Irradiance (PT550)

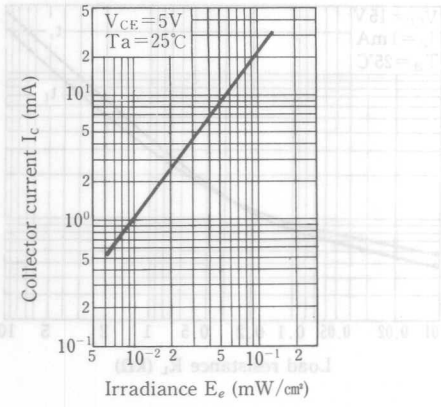


Fig. 5 Collector Current vs. Irradiance (PT550F)

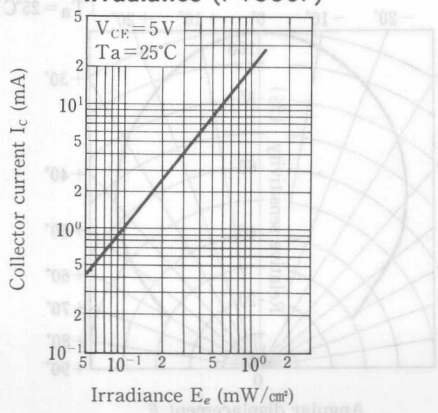
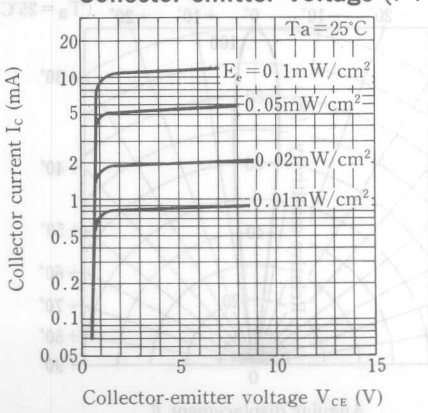


Fig. 6 Collector Current vs. Collector-emitter Voltage (PT550)



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Fig. 7 Collector Current vs. Collector-emitter Voltage (PT550F)

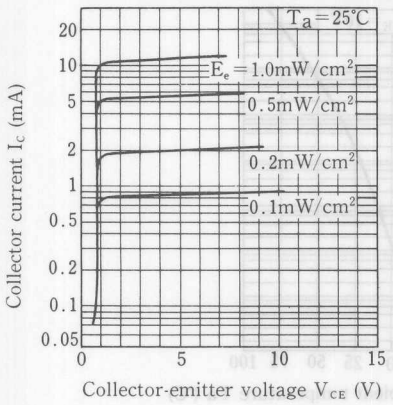


Fig. 8 Spectral Sensitivity

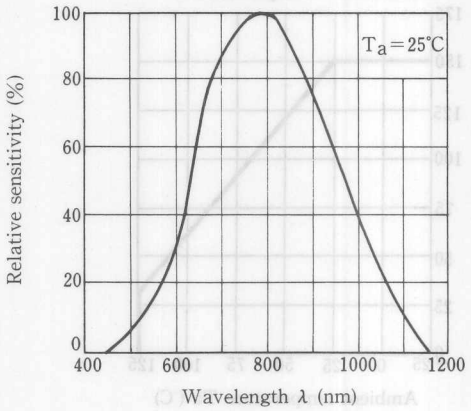
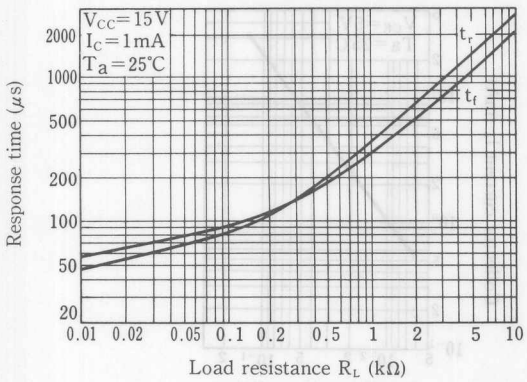


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

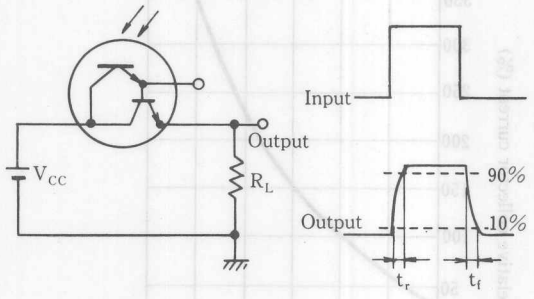


Fig. 10 Sensitivity Diagram (PT550)

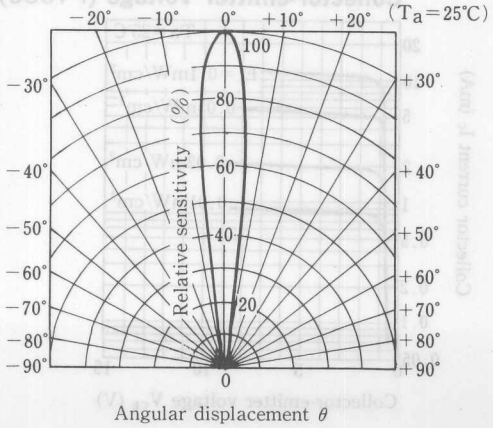


Fig. 11 Sensitivity Diagram (PT550F)

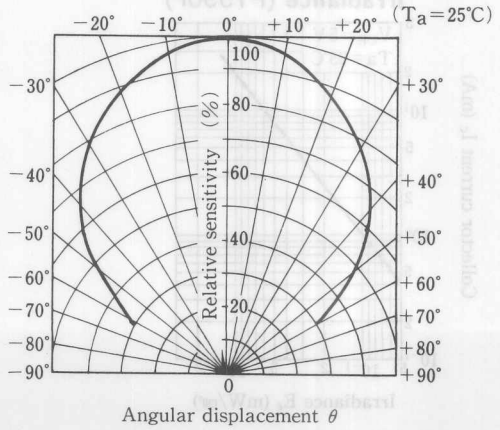


Fig. 12 Collector-emitter Saturation Voltage vs. Irradiance (PT550)

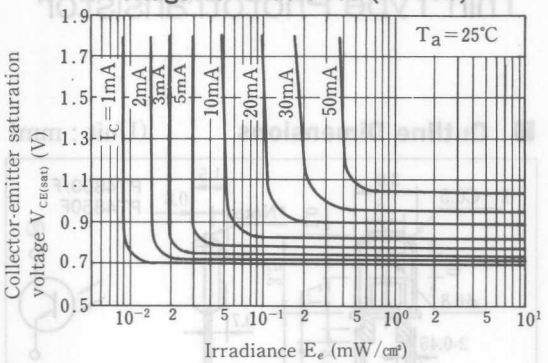
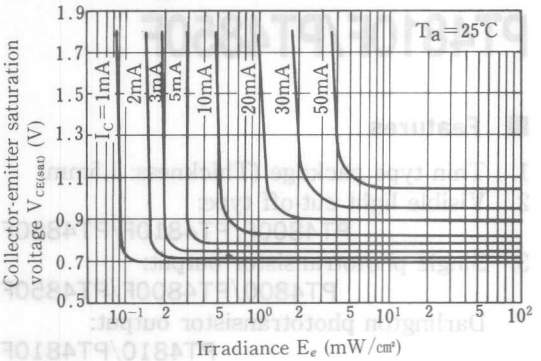


Fig. 13 Collector-emitter Saturation Voltage vs. Irradiance (PT550F)



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PT4800/PT4800F/PT4810 PT4810F/PT4850F

Thin Type Phototransistor

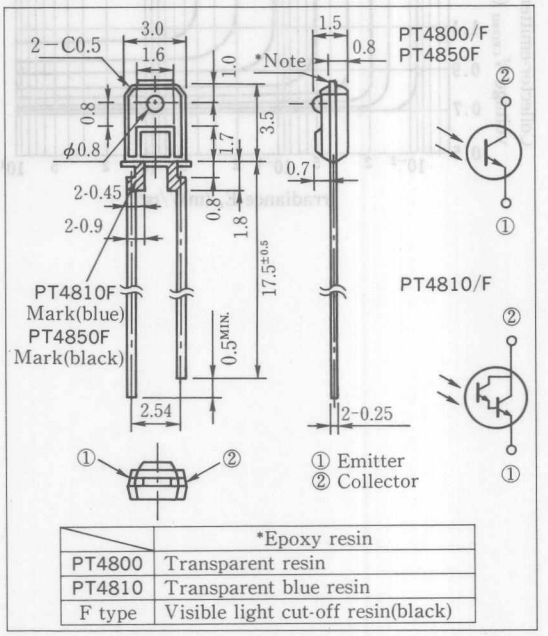
■ Features

1. Thin type package (Thickness: 1.5mm)
2. Visible light cut-off type:
   PT4800F/PT4810F/PT4850F
3. Single phototransistor output:
   PT4800/PT4800F/PT4850F
   Darlington phototransistor output:
   PT4810/PT4810F
4. Thin type

■ Applications

1. VCRs
2. Floppy disk drives

■ Outline Dimensions (Unit : mm)



	*Epoxy resin
PT4800	Transparent resin
PT4810	Transparent blue resin
F type	Visible light cut-off resin(black)

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Collector-emitter voltage		V_{CEO}	35	V
Emitter-collector voltage		V_{ECO}	6	V
Collector current	PT4800/PT4800F/PT4850F	I_C	20	mA
	PT4810/PT4810F		50	
Collector power dissipation		P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+85	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 3 seconds at the position of 1.8mm from the bottom face of resin package

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*2Collector current	PT4800	I_C	E_e=1mW/cm², V_{CE}=5V	0.12	0.4	1.0	mA
	PT4800F			0.08	0.25	0.75	mA
	PT4850F			0.12	—	0.56	mA
	PT4810		E_e=0.1mW/cm², V_{CE}=2V	0.45	—	7.0	mA
	PT4810F			0.27	—	6.0	mA
Collector dark current	PT4800/PT4800F PT4850F	I_{CEO}	E_e=0, V_{CE}=20V	—	—	0.1	μA
	PT4810/PT4810F		E_e=0, V_{CE}=10V	—	—	1.0	μA
*2Collector-emitter saturation voltage	PT4800/PT4800F PT4850F	V_{CE} (sat)	E_e=10mW/cm², I_C=0.5mA	—	—	0.4	V
	PT4810/PT4810F		E_e=1mW/cm², I_C=2.5mA	—	—	1.0	V
Collector-emitter breakdown voltage		BV_{CEO}	I_C=0.1mA, E_e=0	35	—	—	V
Emitter-collector breakdown voltage		BV_{ECO}	I_E=0.01mA, E_e=0	6	—	—	V
Peak sensitivity wavelength	PT4800	λp		—	800	—	nm
	PT4800F			—	860	—	nm
	PT4850F			—	860	—	nm
	PT4810			—	800	—	nm
	PT4810F			—	860	—	nm
Response time (Rise)	PT4800/PT4800F PT4850F	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	3.0	—	μs
	PT4810/PT4810F		V_{CE}=2V, I_C=10mA, R_L=100Ω	—	80	400	μs
Response time (Fall)	PT4800/PT4800F PT4850F	t_f	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	3.5	—	μs
	PT4810/PT4810F		V_{CE}=2V, I_C=10mA, R_L=100Ω	—	70	350	μs
Half intensity angle		Δθ		—	±35	—	deg.

*2 E_e: Irradiance by CIE standard light source A (tungsten lamp)

5

Fig. 1 Collector Power Dissipation vs. Ambient Temperature

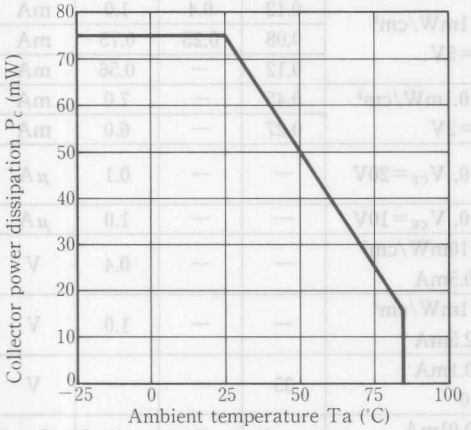


Fig. 2 Collector Dark Current vs. Ambient Temperature (PT4800/PT4800F/PT4850F)

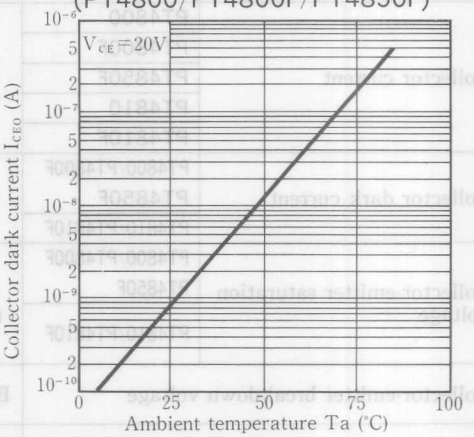


Fig. 3 Collector Dark Current vs. Ambient Temperature (PT4810/PT4810F)

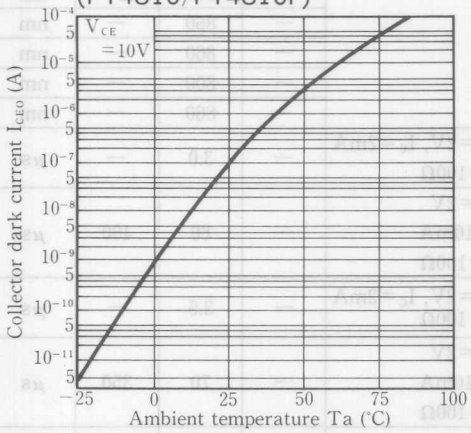


Fig. 4 Relative Collector Current vs. Ambient Temperature (PT4800/PT4800F/PT4850F)

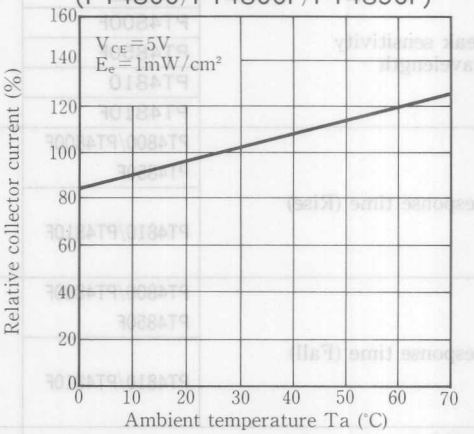


Fig. 5 Relative Collector Current vs. Ambient Temperature (PT4810/PT4810F)

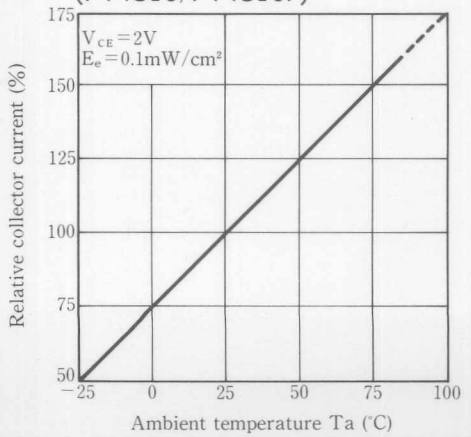


Fig. 6 Collector Current vs. Irradiance (PT4800)

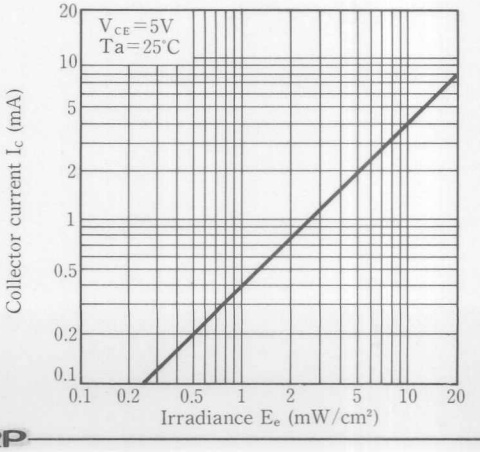


Fig. 7 Collector Current vs. Irradiance (PT4800F/PT4850F)

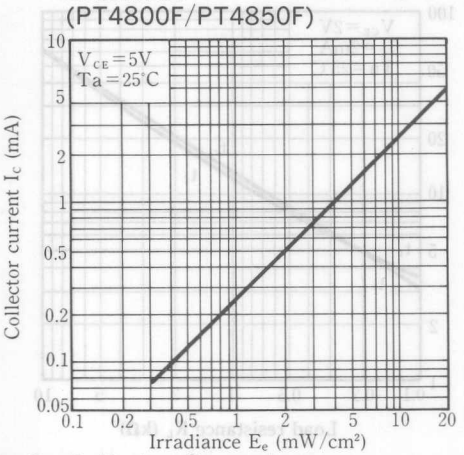


Fig. 8 Collector Current vs. Irradiance (PT4810/PT4810F)

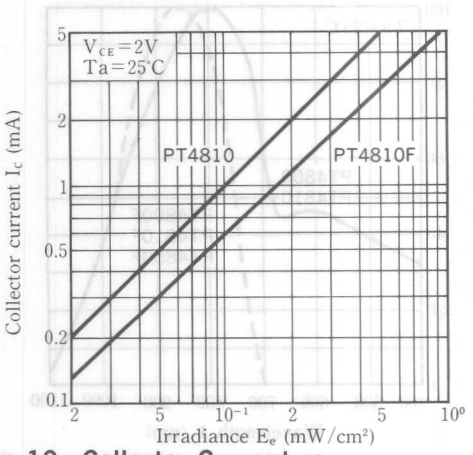


Fig. 9 Collector Current vs. Collector-emitter Voltage (PT4800)

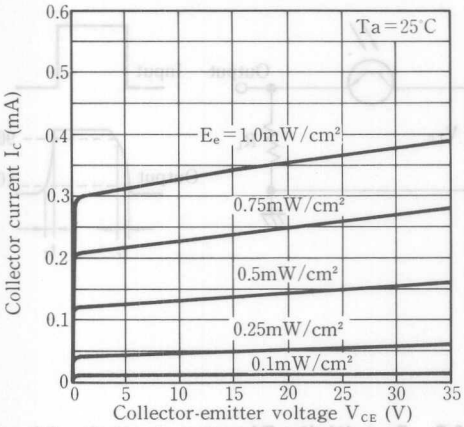


Fig. 10 Collector Current vs. Collector-emitter Voltage (PT4800F/PT4850F)

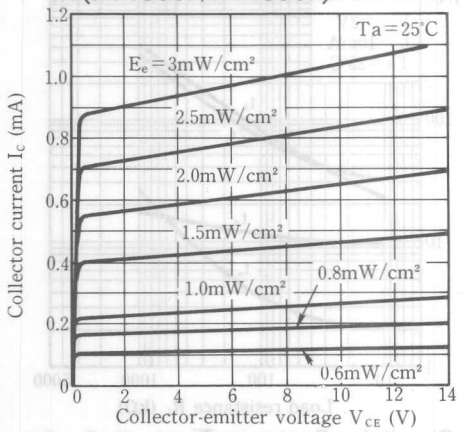


Fig. 11 Collector Current vs. Collector-emitter Voltage (PT4810)

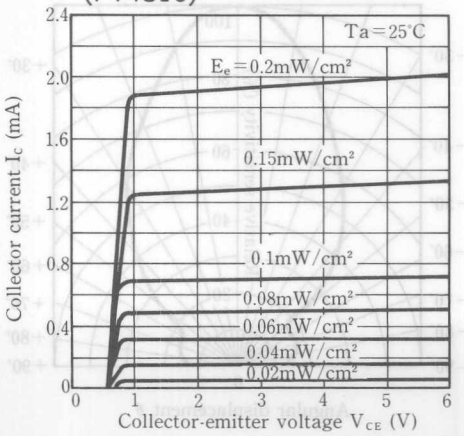
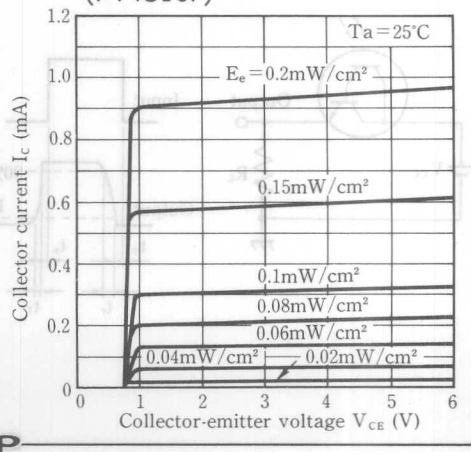


Fig. 12 Collector Current vs. Collector-emitter Voltage (PT4810F)



5

Fig. 13 Spectral Sensitivity

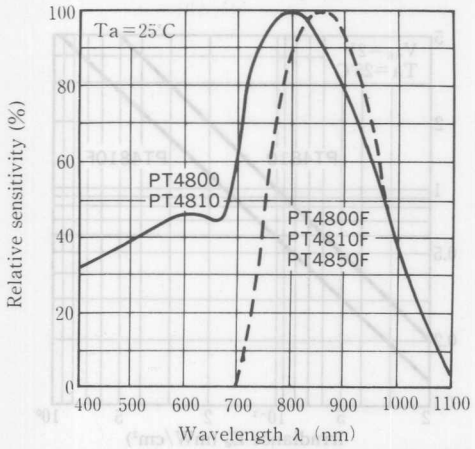


Fig. 14 Response Time vs. Load Resistance (PT4800/PT4800F/PT4850F)

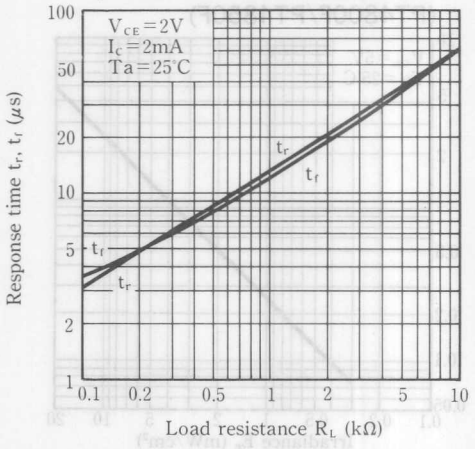
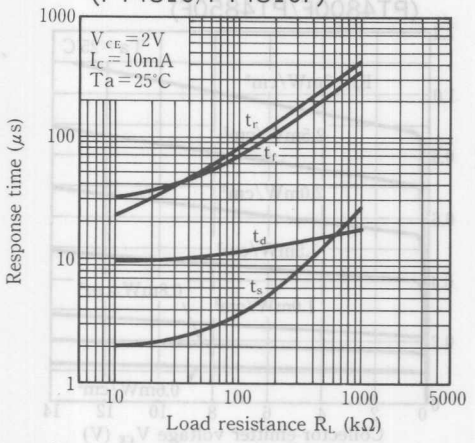
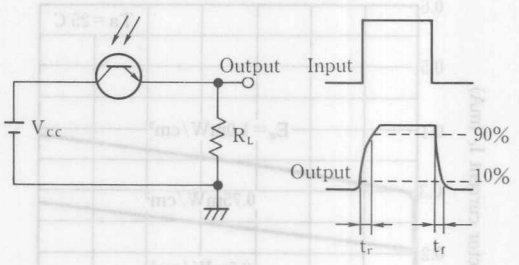


Fig. 15 Response Time vs. Load Resistance (PT4810/PT4810F)



Test Circuit for Response Time (PT4800/PT4800F/PT4850F)



Test Circuit for Response Time (PT4810/PT4810F)

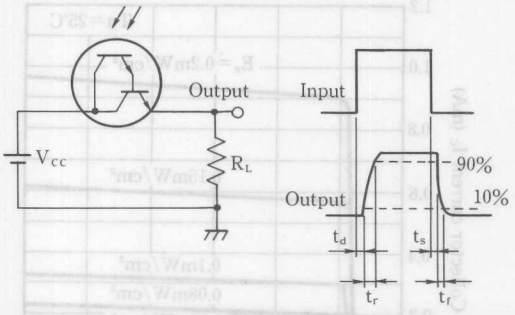


Fig. 16 Sensitivity Diagram (Ta=25°C)

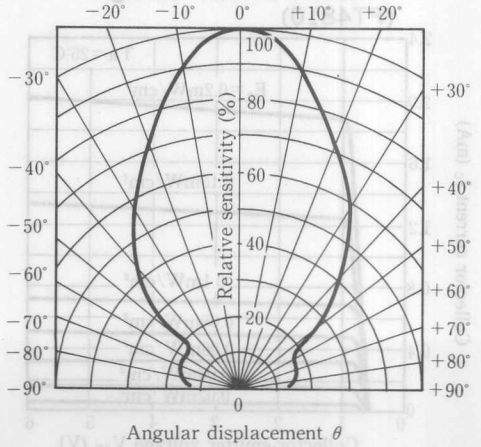


Fig. 17 Collector-emitter Saturation Voltage vs. Irradiance (PT4800)

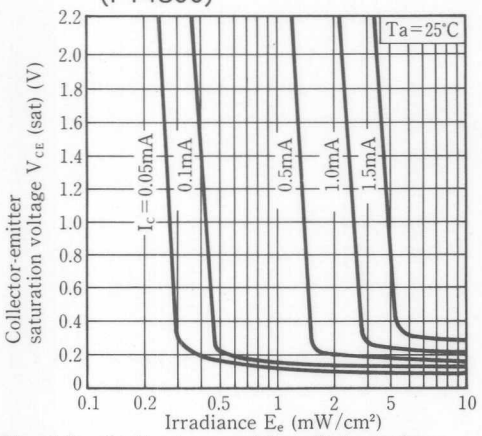


Fig. 18 Collector-emitter Saturation Voltage vs. Irradiance (PT4800F/PT4850F)

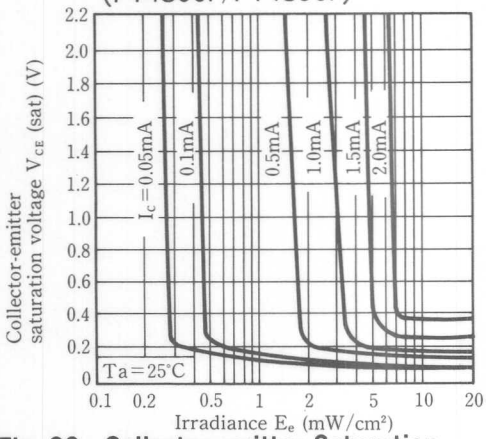


Fig. 19 Collector-emitter Saturation Voltage vs. Irradiance (PT4810)

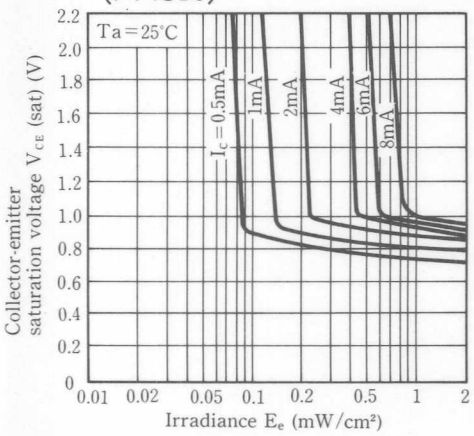


Fig. 20 Collector-emitter Saturation Voltage vs. Irradiance (PT4810F)

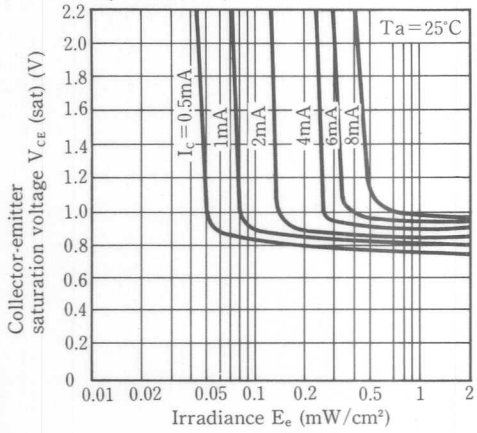


Fig. 21 Relative Output vs. Distance (PT4800F) (Emitter: GL4800)

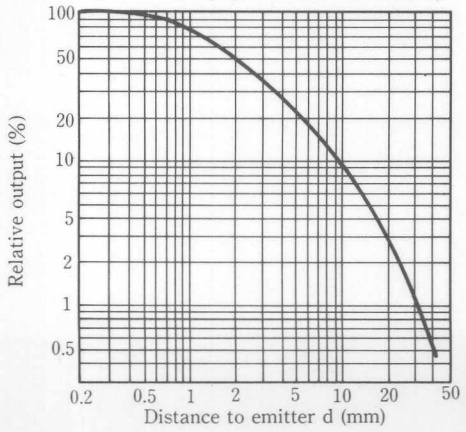
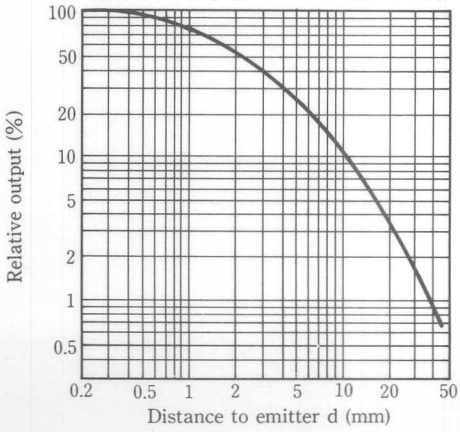


Fig. 22 Relative Output vs. Distance (PT4810F) (Emitter: GL4800)



5

Fig. 17 Collector-emitter Saturation Voltage vs. Irradiance (PT4800)

Fig. 18 Collector-emitter Saturation Voltage vs. Irradiance (PT4800F/PT4850F)

Fig. 19 Collector-emitter Saturation Voltage vs. Irradiance (PT4810)

Fig. 20 Collector-emitter Saturation Voltage vs. Irradiance (PT4810F)

Fig. 21 Relative Output vs. Distance (PT4800F) (Emitter: GL4800)

Fig. 22 Relative Output vs. Distance (PT4810F) (Emitter: GL4800)

Photocouplers/Photothyristor Couplers /Phototriac Couplers

PC100/PC101 VDE Approved, Long Creepage Distance Type Photocoupler

■ Features

1. Long creepage distance type (Creepage distance: 8mm or more)*1
2. Internal insulation distance: 2mm or more
3. VDE approved No. 53181 and UL recognized file No. E64380
4. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
5. Dual-in-line package

*1 Allows pin-to-pin distance minus PWB land space to be 8mm or more.

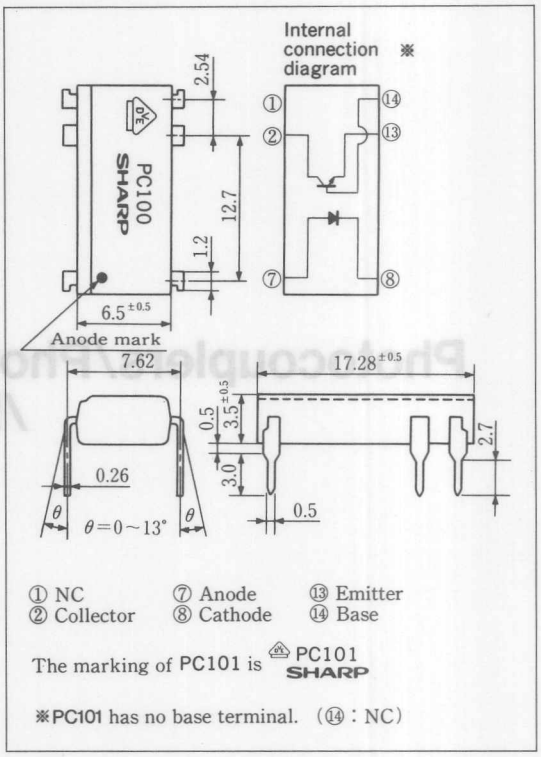
■ Applications

1. Switching power supplies
2. Home appliances and OA equipment for export to Europe

■ VDE Approval Specification (VDE 0883/6.80)

1. Environmental test class 55/125/21
2. Isolation voltage 5,000V AC for 1 minute
3. Isolation group: C group
4. Tracking resistance group: I (KB100/A)
5. Reference voltage: 660V AC/800V DC
6. Clearance-creepage distance: 10.5mm (MIN.)
7. Internal insulation distance: 2.0mm (MIN.)
8. (Conformance standard of Equipment)
   DIN 57 700 Part 1/VDE 0700 Part 1/2.81
   DIN IEC 601 Part 1/VDE0705 Part 1/5.82
   DIN 57 804/VDE 0804/1.83
   DIN IEC 435/VDE 0805 (Plan) Nov. 84
   DIN IEC 380/VDE 0806/8.81
   DIN IEC 65/VDE 0860/8.81

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*2Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	*3Collector-base voltage	V_{CBO}	35	V
	*3Emitter-base voltage	V_{EBO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
	Total power dissipation	P_{tot}	200	mW
	*4Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−30～+100	°C
	Storage temperature	T_{stg}	−55～+125	°C
	*5Soldering temperature	T_{sol}	260	°C

*2 Pulse width≦100μs, Duty ratio=0.001
*3 Applies only to PC100.
*4 RH=40～60%, AC for 1 minute
*5 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=10mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0, *6R_{BE}=∞	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=10mA, V_{CE}=5V, *6R_{BE}=∞	25	60	180	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA, *6R_{BE}=∞	—	0.1	0.3	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{12}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_C	V_{CE}=5V, I_C=2mA, R_L=100Ω, *6R_{BE}=∞	—	40	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	6	23	μs
	Response time (Fall)	t_f	R_L=100Ω, *6R_{BE}=∞	—	8	27	μs

*6 PC100 only

6

Fig. 1 Forward Current vs. Ambient Temperature

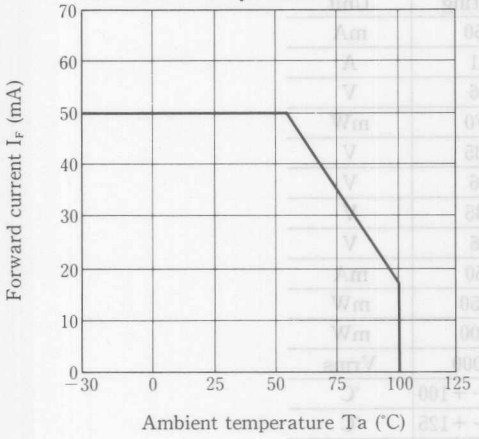


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

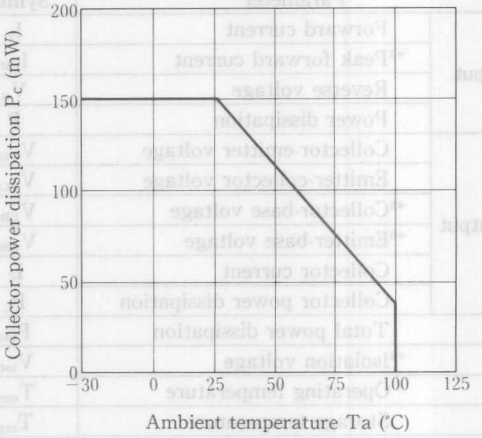


Fig. 3 Peak Forward Current vs. Duty Ratio

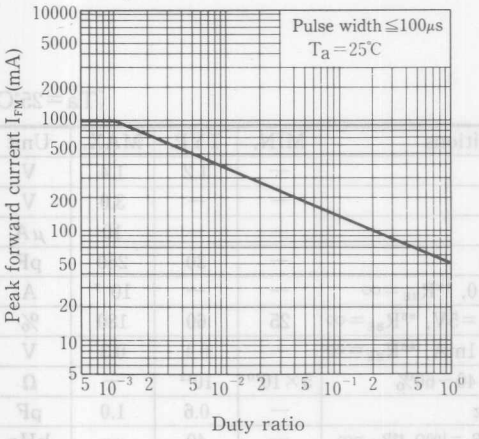


Fig. 4 Forward Current vs. Forward Voltage

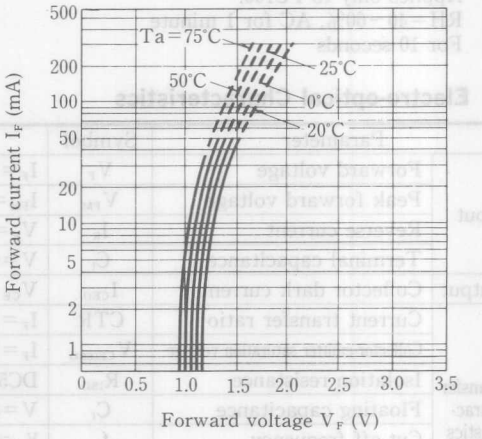


Fig. 5 Current Transfer Ratio vs. Forward Current

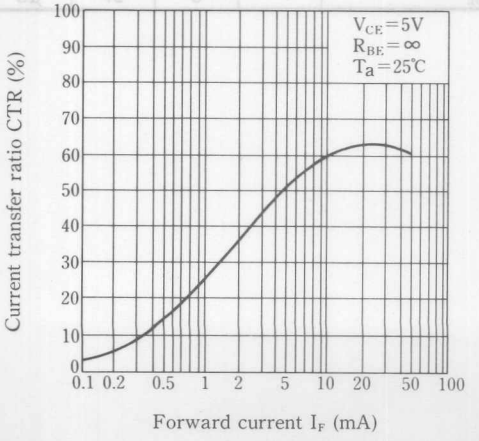


Fig. 6 Collector Current vs. Collector-emitter Voltage

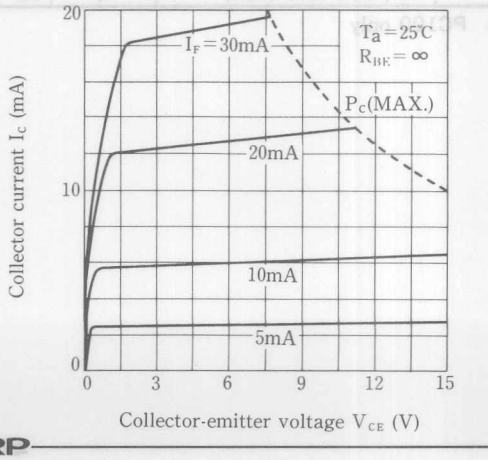


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

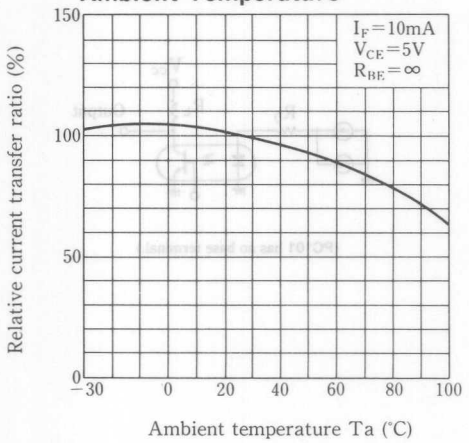


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

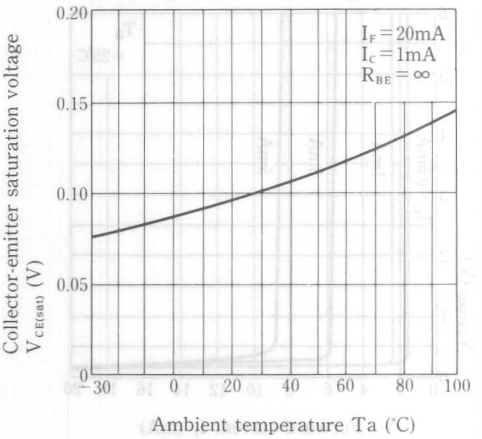


Fig. 9 Collector Dark Current vs. Ambient Temperature

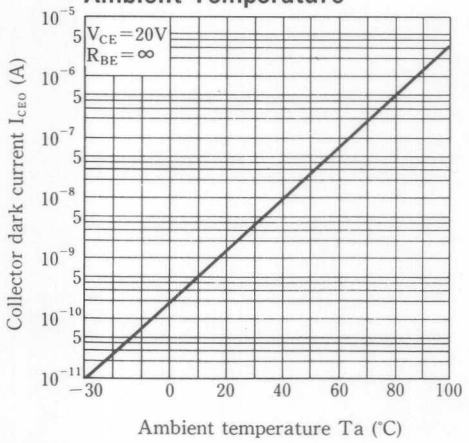
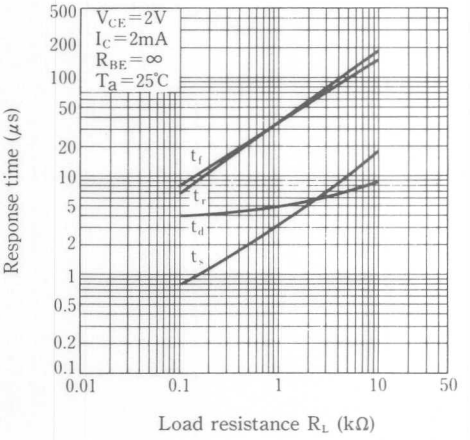
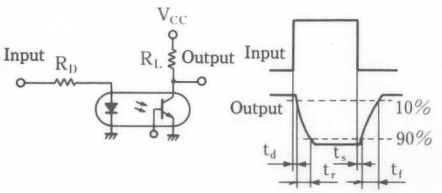


Fig. 10 Response Time vs. Load Resistance

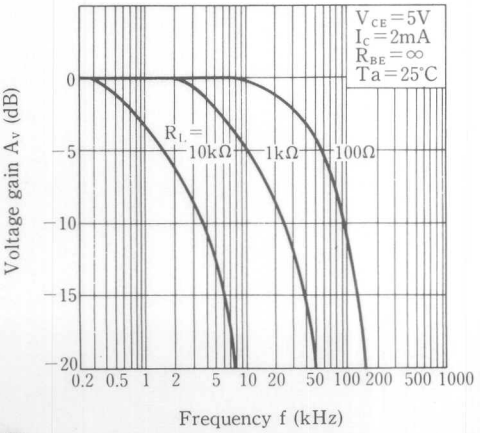


Test Circuit for Response Time



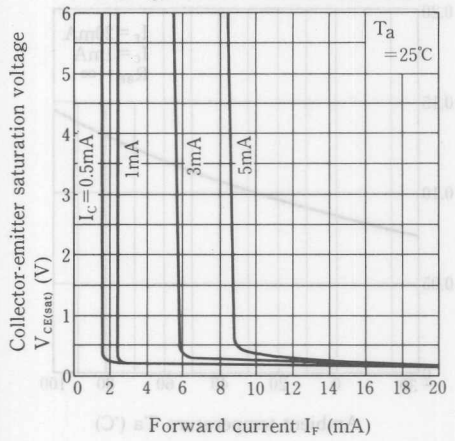
(PC101 has no base terminal.)

Fig. 11 Frequency Response

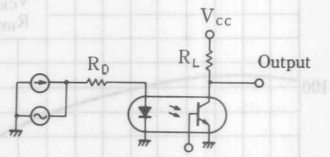


6

Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



(PC101 has no base terminal.)

PC110/PC111 PC112/PC113

VDE Approved, Long Creepage Distance Type Photocoupler

■ Features

1. Long creepage distance type (Creepage distance: 8mm or more)*1
2. Internal insulation distance: 0.5mm or more
3. VDE approved No. 53182 and UL recognized file No. E64380
4. High collector-emitter voltage (V_{CEO}: 70V): PC112/PC113
5. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
6. Dual-in-line package

*1 Allows pin-to-pin distance minus PWB land space to be 8mm or more.

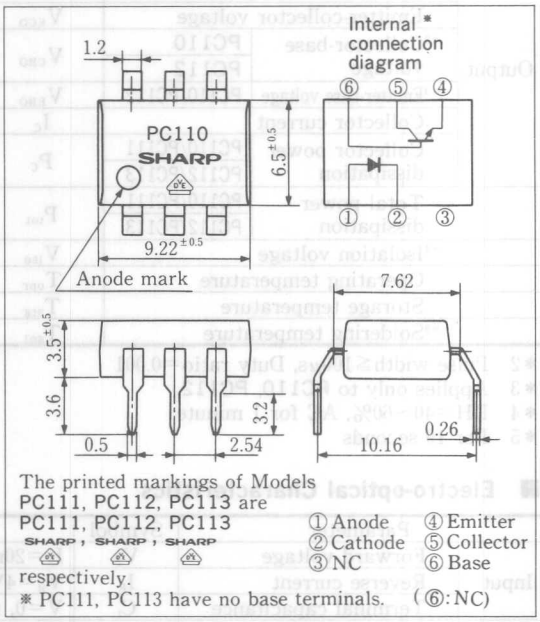
■ Applications

1. Switching power supplies
2. Home appliances and OA equipment for export to Europe
3. System appliances, measuring instruments

■ VDE Approval Specification (VDE 0883/6.80)

1. Environmental test class 55/125/21
2. Isolation voltage 5,000V AC for 1 minute
3. Isolation group: C group
4. Tracking resistance group: I (KB100/A)
5. Reference voltage: 500V AC/600V DC
6. Clearance creepage distance: 8.0mm (MIN.)
7. Internal insulation distance: 0.5mm (MIN.)
8. (Conformance standard of Equipment) DIN IEC601 Part 1/VDE0750 Part 1/5.82 DIN57 804/VDE0804/1.83 DIN IEC435/ VDE0805 (Plan) Nov. 84 DIN IEC380/ VDE0806/8.81 DIN IEC65/VDE0860

■ Outline Dimensions (Unit : mm)



The printed markings of Models PC111, PC112, PC113 are PC111, PC112, PC113
SHARP , SHARP , SHARP
respectively.

① Anode ④ Emitter
② Cathode ⑤ Collector
③ NC ⑥ Base

* PC111, PC113 have no base terminals. (⑥: NC)

6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter			Symbol	Rating	Unit
Input	Forward current		I_F	50	mA
	*2Peak forward current		I_{FM}	1	A
	Reverse Voltage		V_R	6	V
	Power dissipation		P	70	mW
Output	Collector-emitter voltage	PC110/PC111	V_{CEO}	35	V
		PC112/PC113		70	
	Emitter-collector voltage		V_{ECO}	6	V
	*3Collector-base voltage	PC110	V_{CBO}	35	V
		PC112		70	
	*3Emitter-base voltage	PC110/PC112	V_{EBO}	6	V
	Collector current		I_C	50	mA
	Collector power dissipation	PC110/PC111	P_C	150	mW
		PC112/PC113		160	
	Total power dissipation	PC110/PC111	P_{tot}	170	mW
		PC112/PC113		200	
*4Isolation voltage			V_{iso}	5,000	Vrms
Operating temperature			T_{opr}	−30～+100	°C
Storage temperature			T_{stg}	−55～+125	°C
*5Soldering temperature			T_{sol}	260	°C

*2 Pulse width≦100μs, Duty ratio=0.001
*3 Applies only to PC110, PC112.
*4 RH=40～60%, AC for 1 minute
*5 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current		I_R	V_R=4V	—	—	10	μA
	Terminal capacitance		C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current		I_{CEO}	V_{CE}=20V, I_F=0, *6R_{BE}=∞	—	—	10^{-7}	A
Transfer characteristics	*7Current transfer ratio	PC110/PC111	CTR	I_F=5mA, V_{CE}=5V, *6R_{BE}=∞	50	100	400	%
		PC112/PC113		I_F=10mA, V_{CE}=5V, *6R_{BE}=∞	40	—	320	
	Collector-emitter saturation voltage		$V_{CE(sat)}$	I_F=20mA, I_C=1mA, *6R_{BE}=∞	—	0.1	0.2	V
	Isolation resistance		R_{ISO}	DC500V, RH=40～60%	5×10^{10}	1×10^{11}	—	Ω
	Floating capacitance		C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency		f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω, *6R_{BE}=∞	—	80	—	kHz
	Response time (Rise)	PC110/PC111	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω, *6R_{BE}=∞	—	4	18	μs
		PC112/PC113			—	4	15	
	Response time (Fall)	PC110/PC111	t_f		—	3	18	μs
		PC112/PC113			—	3	15	

*6 Applies only to PC110, PC112.
*7 Classifcation table of current transfer ratio is shown below.

PC110/PC111

Model No.	CTR (%)
PC110A/PC111A	50～125
PC110B/PC111B	100～250
PC110AB/PC111AB	50～250
PC110/PC111	50～400

PC112/PC113

Model No.	CTR (%)
PC112A/PC113A	40～120
PC112B/PC113B	80～200
PC112AB/PC113AB	40～200
PC112/PC113	40～320

Fig. 1 Forward Current vs. Ambient Temperature

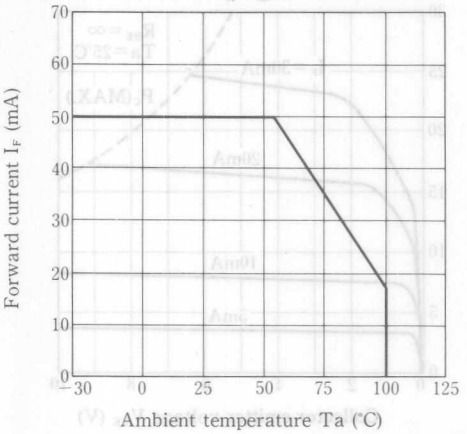


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

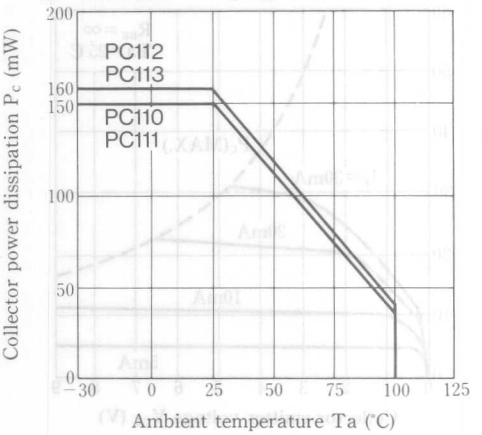


Fig. 3 Peak Forward Current vs. Duty Ratio

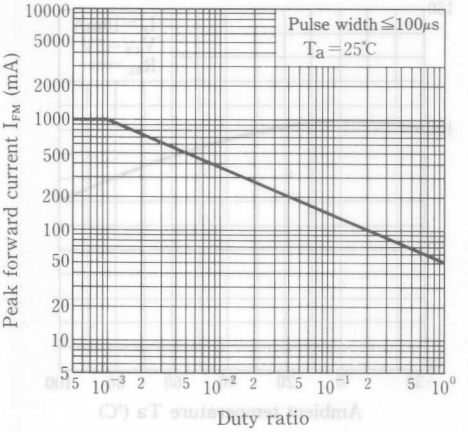


Fig. 4 Forward Current vs. Forward Voltage

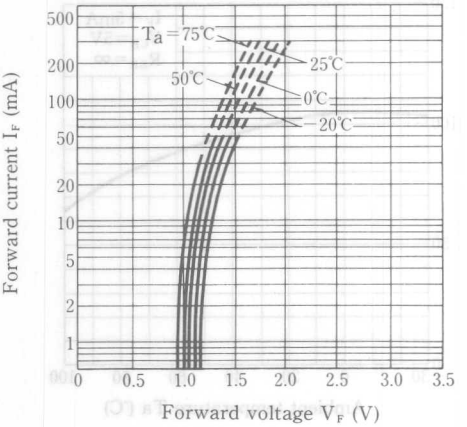
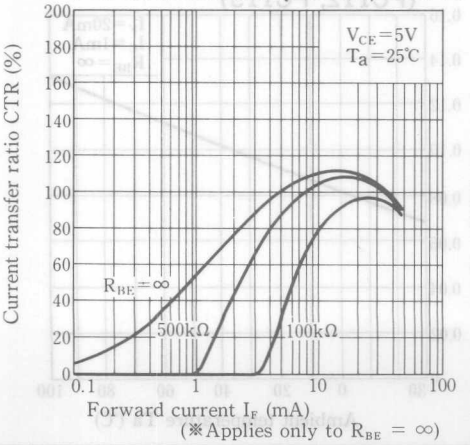
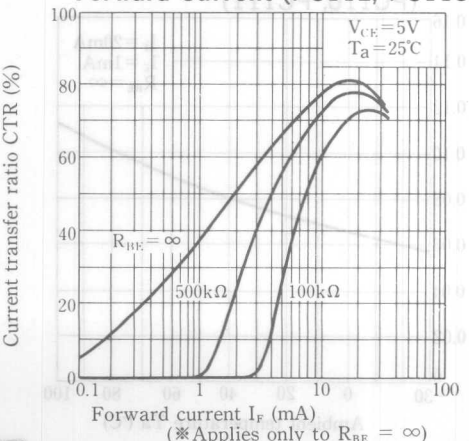


Fig. 5 Current Transfer Ratio vs. Forward Current (PC110, PC111※)



(※Applies only to R_{BE} = ∞)

Fig. 6 Current Transfer Ratio vs. Forward Current (PC112, PC113※)



(※Applies only to R_{BE} = ∞)

6

Fig. 7 Collector Current vs. Collector-emitter Voltage (PC110, PC111)

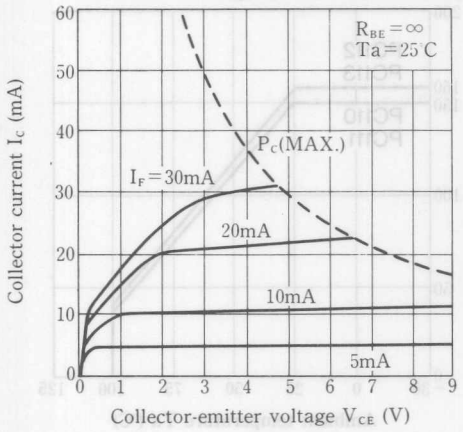


Fig. 8 Collector Current vs. Collector-emitter Voltage (PC112, PC113)

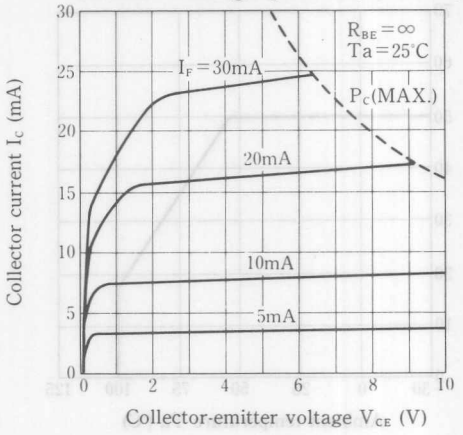


Fig. 9 Relative Current Transfer Ratio vs. Ambient Temperature (PC110, PC111)

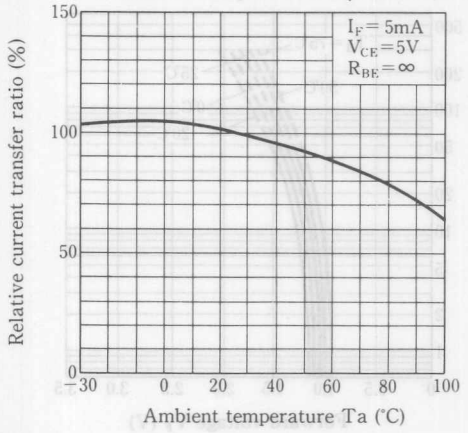


Fig. 10 Relative Current Transfer Ratio vs. Ambient Temperature(PC112,PC113)

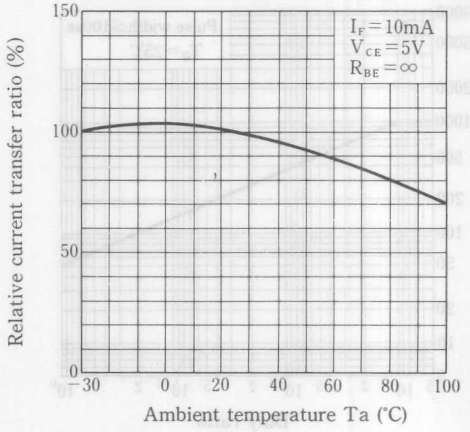


Fig. 11 Collector-emitter Saturation Voltage vs. Ambient Temperature (PC110, PC111)

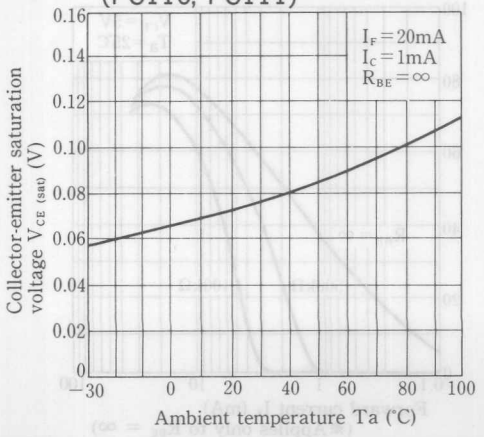


Fig. 12 Collector-emitter Saturation Voltage vs. Ambient Temperature (PC112, PC113)

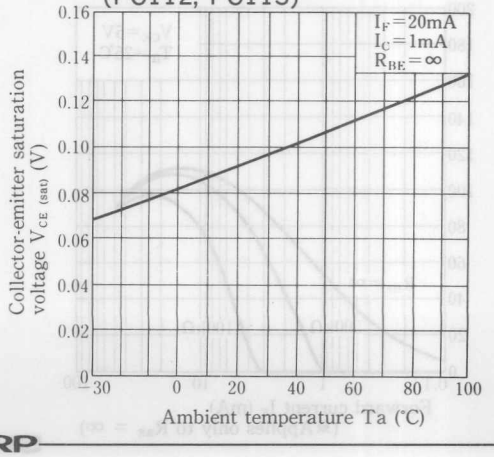


Fig. 13 Collector Dark Current vs. Ambient Temperature (PC110, PC111)

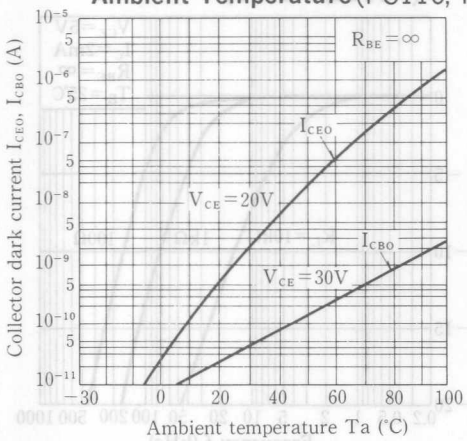


Fig. 14 Collector Dark Current vs. Ambient Temperature (PC112, PC113)

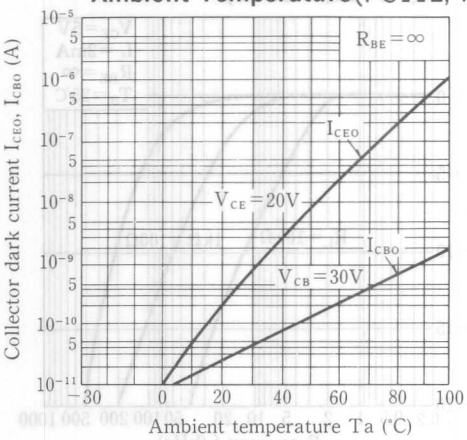


Fig. 15 Response Time vs. Load Resistance (PC110, PC111)

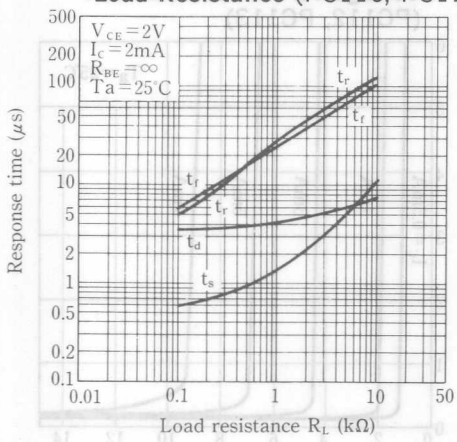
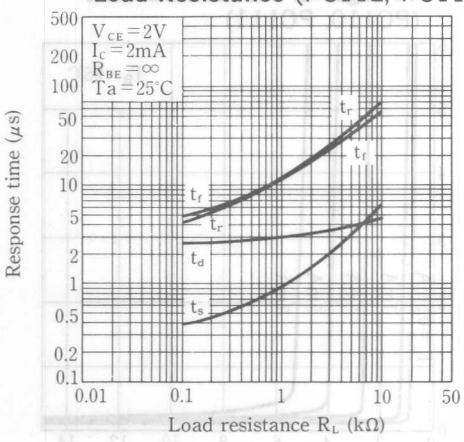
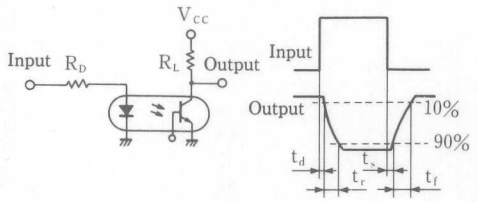


Fig. 16 Response Time vs. Load Resistance (PC112, PC113)

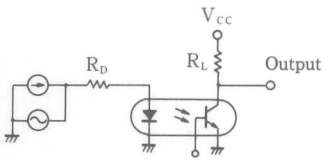


Test Circuit for Response Time



(PC111,PC113 have no base terminal.)

Test Circuit for Frequency Response



(PC111, PC113 have no base terminal.)

6

Fig. 17 Frequency Response (PC110, PC111)

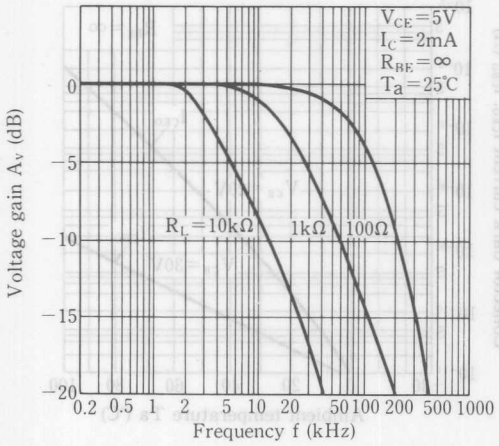


Fig. 18 Frequency Response (PC112, PC113)

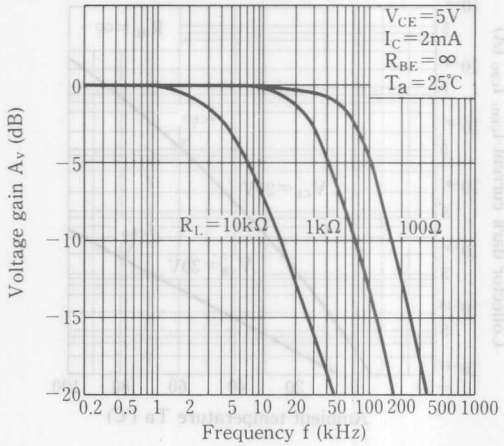


Fig. 19 Collector-emitter Saturation Voltage vs. Forward Current (PC110, PC111)

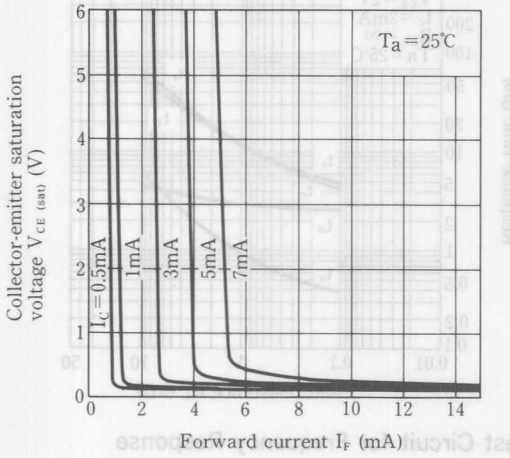
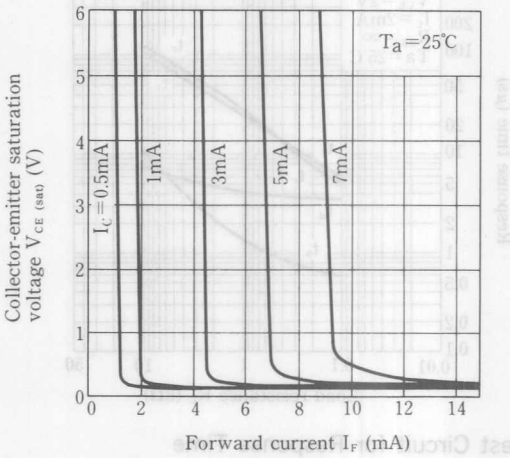


Fig. 20 Collector-emitter Saturation Voltage vs. Forward Current (PC112, PC113)



PC219 Mini-Flat Package, Bi-Directional Linear Output Type Photocoupler

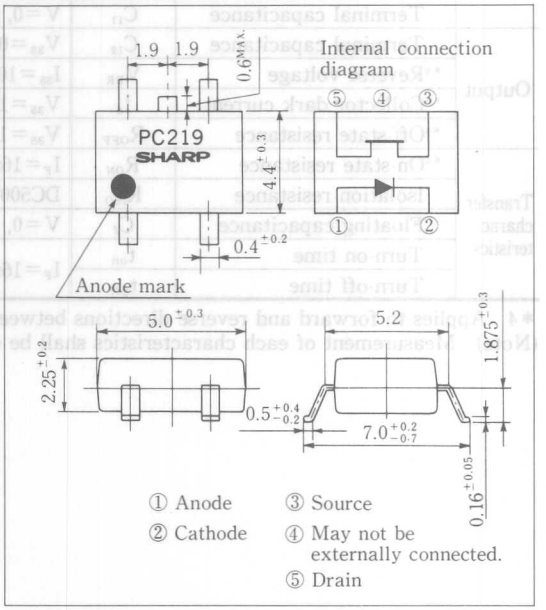
■ Features

1. Bi-directional linear output
2. High output reverse voltage (V_{BR}: MIN. 120V)
3. Low collector dark current (Id : MAX. 10nA)
4. Mini-flat package type

■ Applications

1. Programmable controllers
2. Analog switches
3. Audio equipment such as VCRs, radio-cassette tape recorders and stereo components, etc.
4. Signal transmission between circuits of differential potentials and impedances

■ Outline Dimensions (Unit : mm)



6

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak Forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Output current	I_o	10	mA
	Reverse voltage	V_{BR}	120	V
	Power dissipation	P_o	100	mW
	Total power dissipation	P_{tot}	120	mW
	*2Isolation voltage	V_{iso}	2,000	Vrms
	Operating temperature	T_{opr}	−25～+100	°C
	Storage temperature	T_{stg}	−40～+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=16mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=6V	—	—	10	μA
	Terminal capacitance	C_{11}	V=0, f=1kHz	—	50	250	pF
Output	Terminal capacitance	C_{12}	V_{35}=0, f=1MHz	—	—	25	pF
	*4Reverse voltage	V_{BR}	I_{35}=100μA, I_F=0	120	—	—	V
	*4Collector dark current	I_d	V_{35}=100V, I_F=0	—	—	10	nA
	*4Off-state resistance	R_{OFF}	V_{35}=100V, I_F=0	10^{10}	—	—	Ω
Transfer characteristics	*4On-state resistance	R_{ON}	I_F=16mA, I_{35}=100μA	—	—	200	Ω
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	—	2.5	pF
	Turn-on time	t_{on}	I_F=16mA, V_{35}=5V, R_L=50Ω	—	—	50	μs
	Turn-off time	t_{off}		—	—	50	μs

*4 Applies to forward and reverse directions between terminals 3 and 5.

(Note) Measurement of each characteristics shall be carried out in opaque condition.

Fig. 1 Forward Current vs. Ambient Temperature

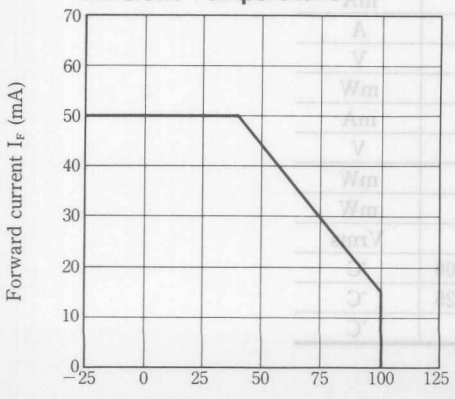


Fig. 2 Output Power Dissipation vs. Ambient Temperature

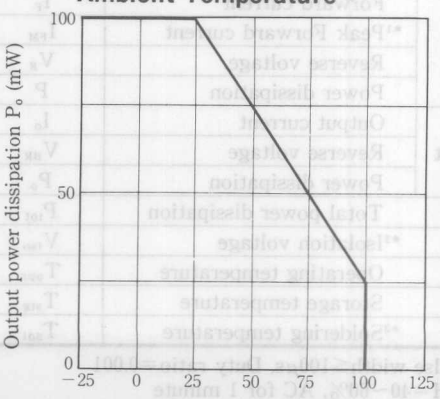


Fig. 3 Peak Forward Current vs. Duty Ratio

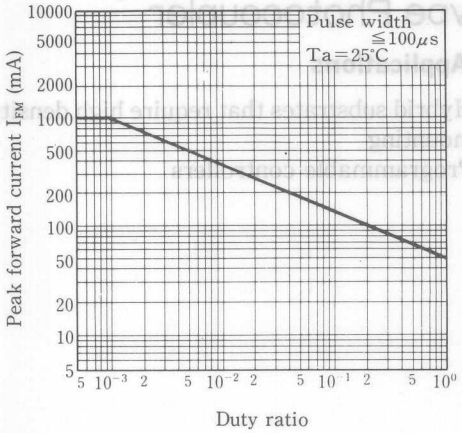


Fig. 4 Forward Current vs. Forward Voltage

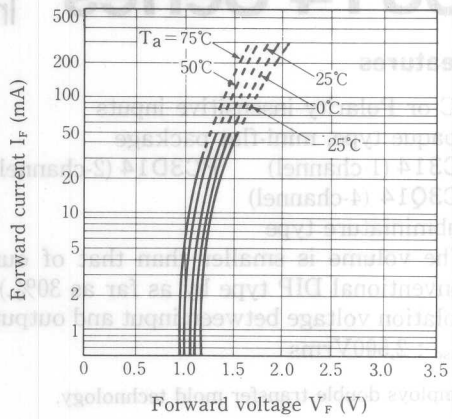


Fig. 5 Output Current vs. Output Voltage

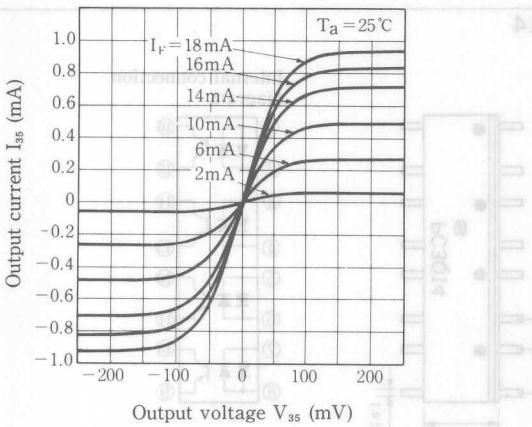


Fig. 6 Relative On-state Resistance vs. Forward Current

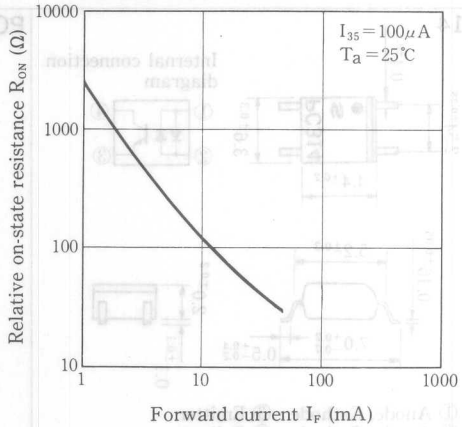


Fig. 7 Relative On-state Resistance vs. Ambient Temperature

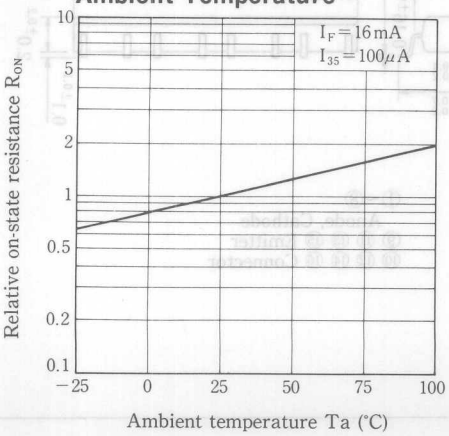
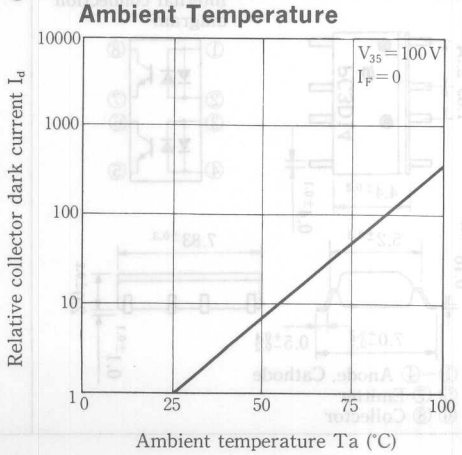


Fig. 8 Relative Collector Dark Current vs. Ambient Temperature



6

PC314 Series

Opaque*, Mini-Flat Package, AC Input Type Photocoupler

■ Features

1. AC or Polarity insensitive inputs
2. Opaque type, mini-flat package
   PC314 (1-channel) PC3D14 (2-channel)
   PC3Q14 (4-channel)
3. Subminiature type
   (The volume is smaller than that of our conventional DIP type by as far as 30%.)
4. Isolation voltage between input and output
   V_{iso} : 2,500Vrms

* Employs double transfer mold technology.

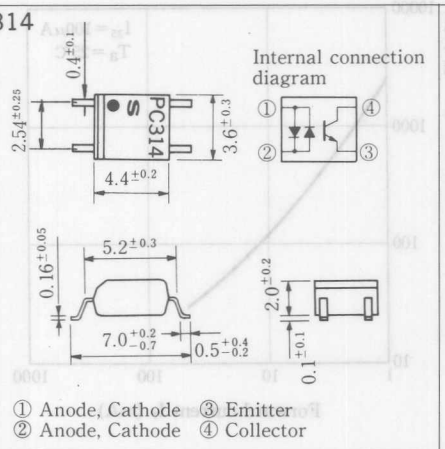
■ Applications

1. Hybrid substrates that require high density mounting
2. Programmable controllers

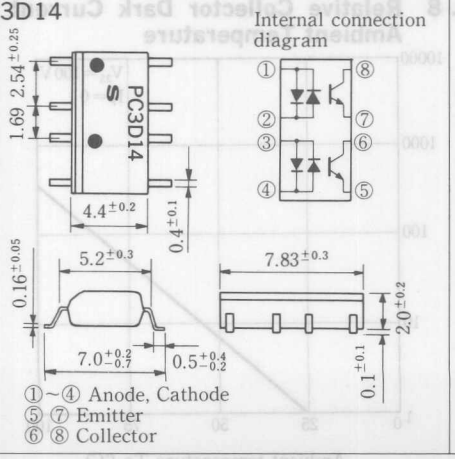
■ Outline Dimensions

(Unit : mm)

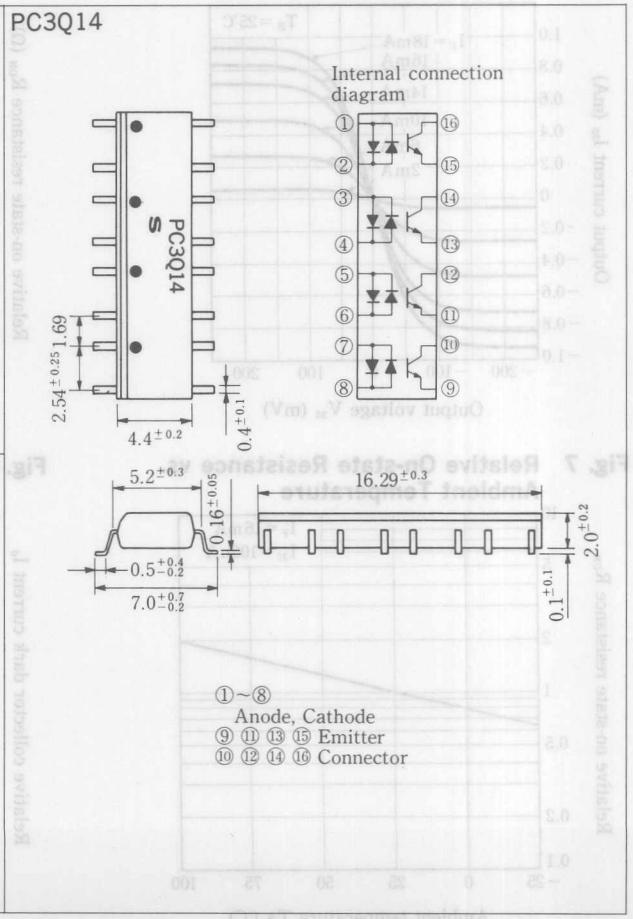
PC314



PC3D14



PC3Q14



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	±50	mA
	*1Peak forward current	I_{FM}	±1	A
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
	Total power dissipation	P_{tot}	170	mW
	*2Isolation voltage	V_{iso}	2,500	Vrms
	Operating temperature	T_{opr}	−30～+100	°C
	Storage temperature	T_{stg}	−40～+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=±20mA	—	1.2	1.4	V
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=±1mA, V_{CE}=5V	20	—	300	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=±20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	4	18	μs
	Response time (Fall)	t_f	R_L=100Ω	—	3	18	μs

6

Fig. 1 Forward Current vs. Ambient Temperature

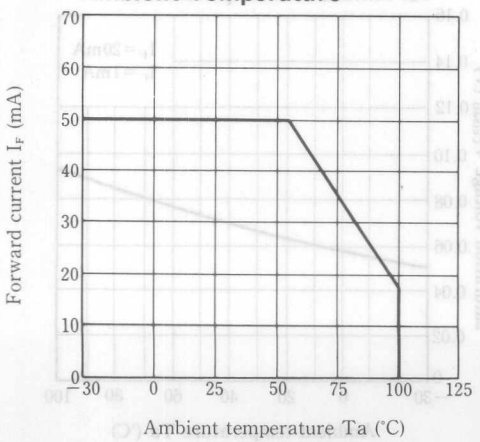


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

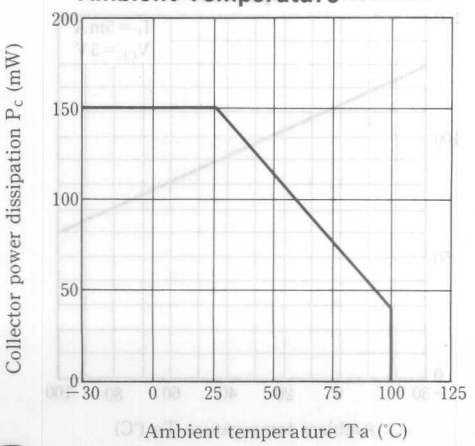


Fig. 3 Peak Forward Current vs. Duty Ratio

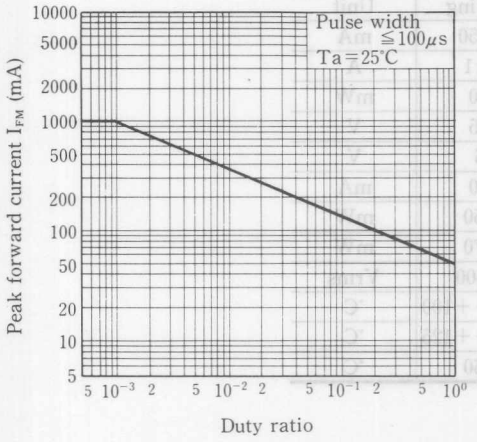


Fig. 4 Forward Current vs. Forward Voltage

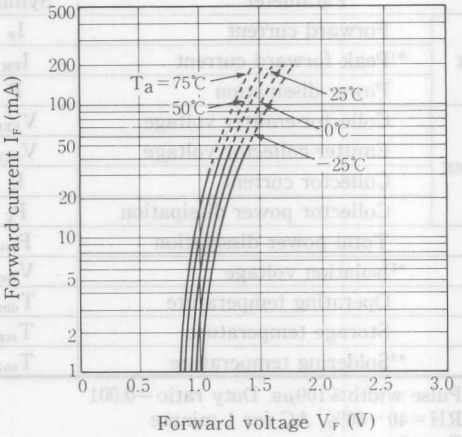


Fig. 5 Current Transfer Ratio vs. Forward Current

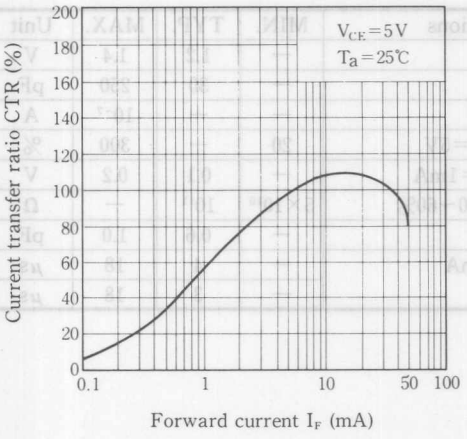


Fig. 6 Collector Current vs. Collector-emitter Voltage

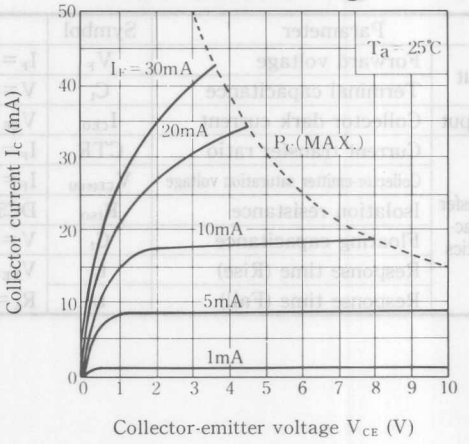


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

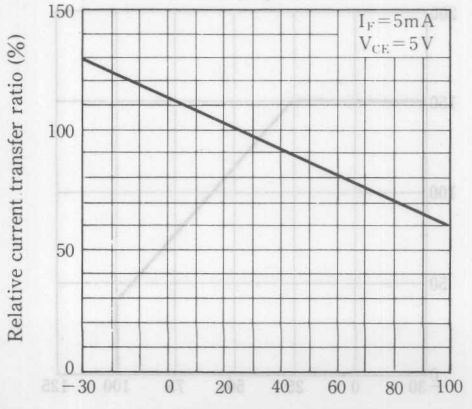


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

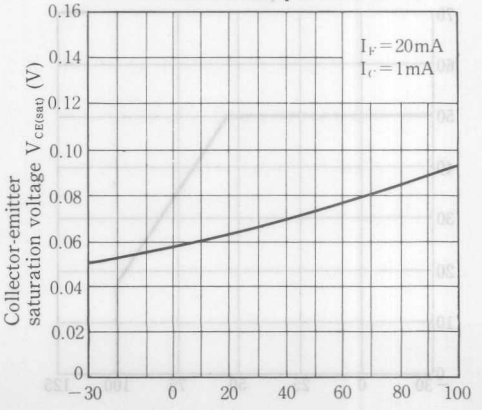


Fig. 9 Collector Dark Current vs. Ambient Temperature

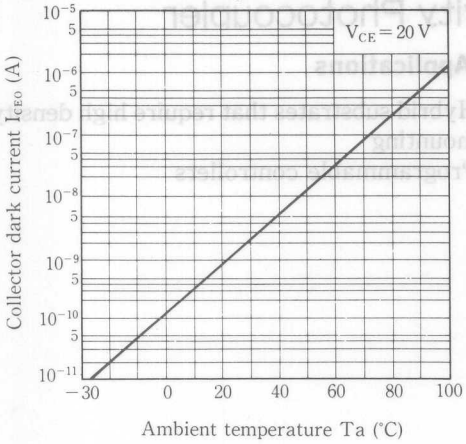
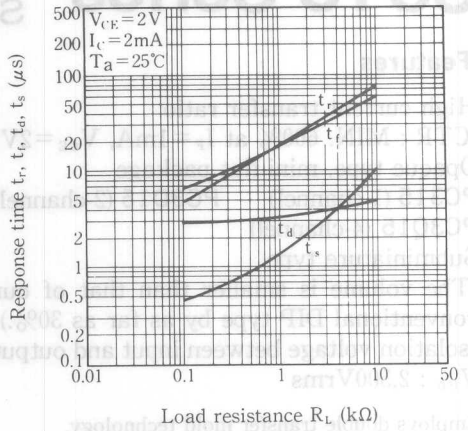


Fig. 10 Response Time vs. Load Resistance



Test Circuit for Response Time

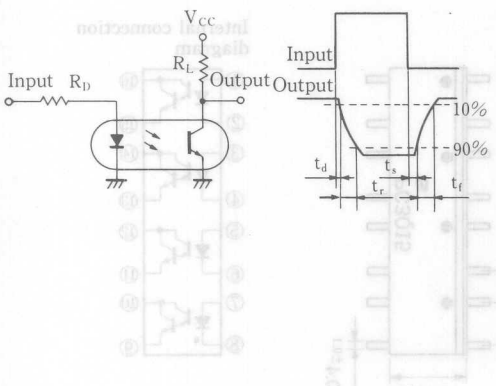
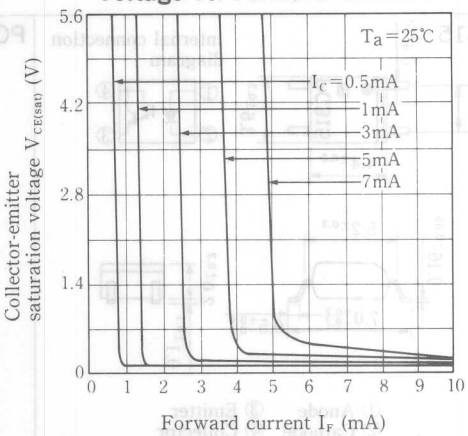


Fig. 11 Collector-emitter Saturation Voltage vs. Forward Current



Package Specification of PC300 Series (1-ch type)

Model No.	Sales Unit	Package Specifications	Diameter of Reel	Tape Width
PC3＊＊Z	1 pc.	Sleeve package (Net: 125 pcs.)	—	—
PC3＊＊	3,000 pcs.	Taping package (Net: 3,000 pcs.)	φ370mm	12mm
PC3＊＊T	750 pcs.	Taping package (Net: 750 pcs.)	φ178mm	12mm

6

PC315 Series

Opaque*, Mini-Flat Package, High Sensitivity Photocoupler

■ Features

1. High current transfer ratio
   (CTR : MIN. 600% at I_F=1mA, V_{CE}=2V)
2. Opaque type, mini-flat package
   PC315 (1-channel) PC3D15 (2-channel)
   PC3Q15 (4-channel)
3. Subminiature type
   (The volume is smaller than that of our conventional DIP type by as far as 30%.)
4. Isolation voltage between input and output
   V_{iso} : 2,500Vrms

* Employs double transfer mold technology.

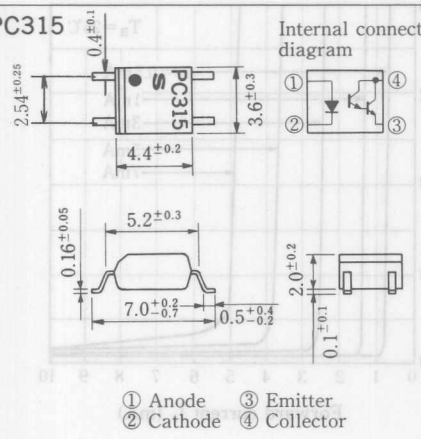
■ Applications

1. Hybrid substrates that require high density mounting
2. Programmable controllers

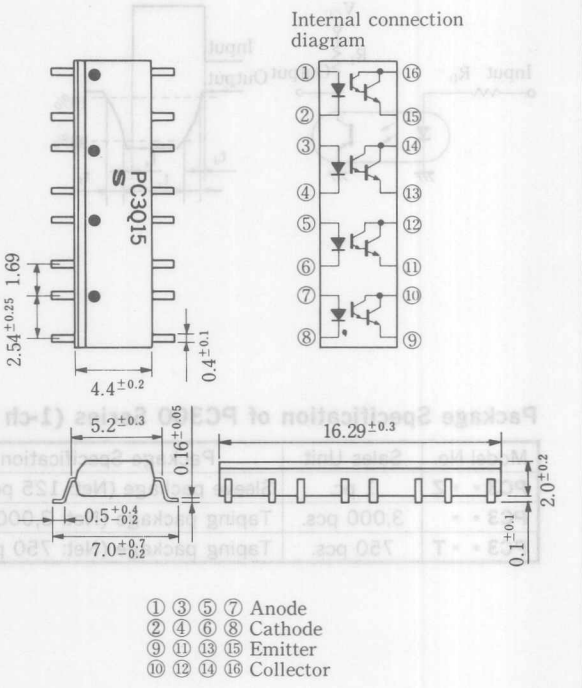
■ Outline Dimensions

(Unit : mm)

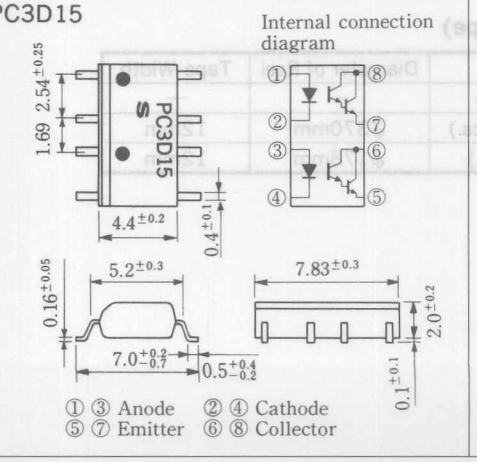
PC315



PC3Q15



PC3D15



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	80	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	170	mW
*2Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	−30～+100	°C
Storage temperature		T_{stg}	−40～+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=10V, I_F=0	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	600	1,600	7,500	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.8	1.0	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	60	300	μs
	Response time (Fall)	t_f	R_L=100Ω	—	53	250	μs

Fig. 1 Forward Current vs. Ambient Temperature

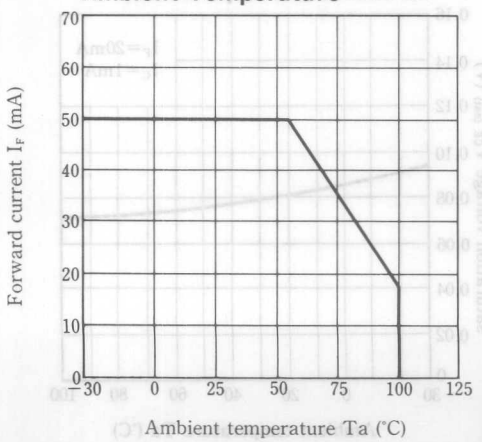
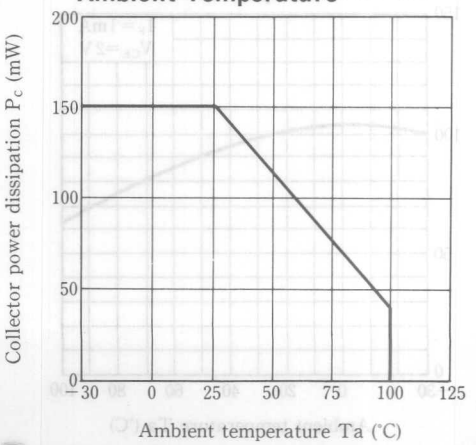


Fig. 2 Collector Power Dissipation vs. Ambient Temperature



6

Fig. 3 Peak Forward Current vs. Duty Ratio

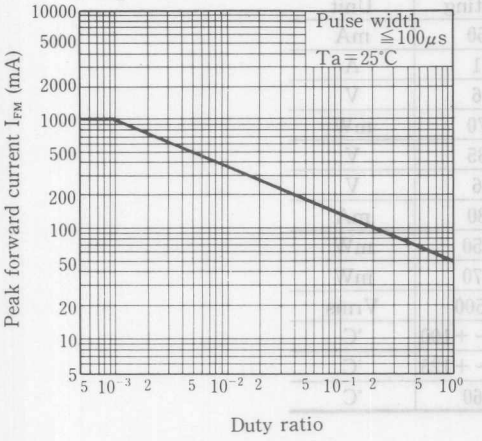


Fig. 4 Forward Current vs. Forward Voltage

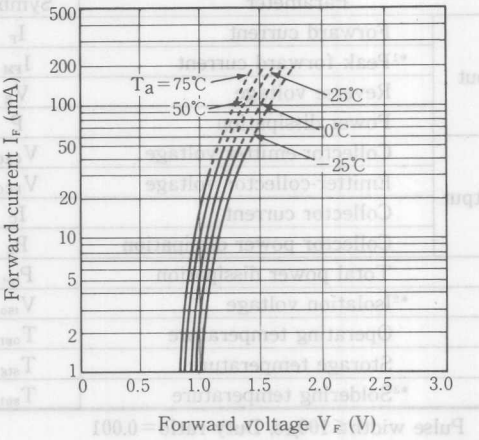


Fig. 5 Current Transfer Ratio vs. Forward Current

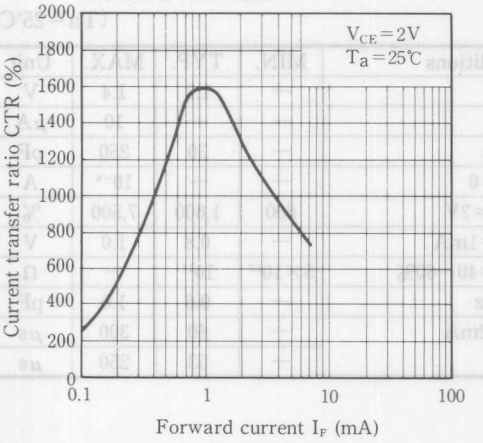


Fig. 6 Collector Current vs. Collector-emitter Voltage

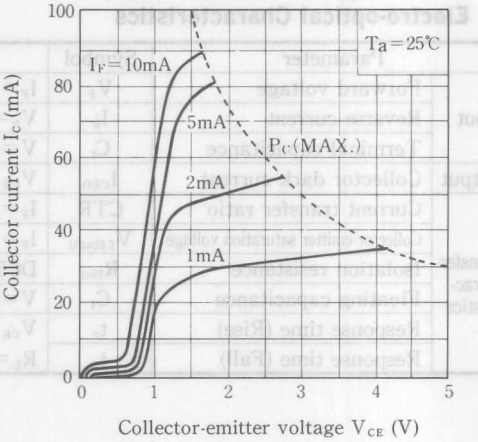


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

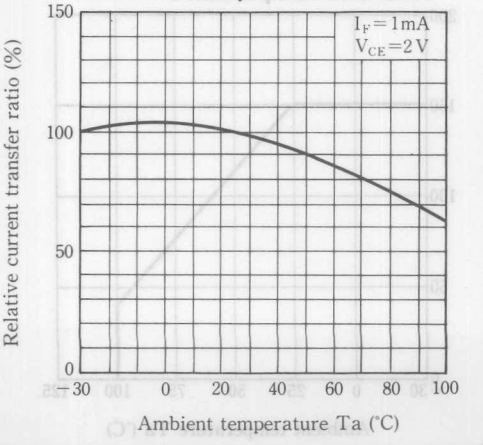


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

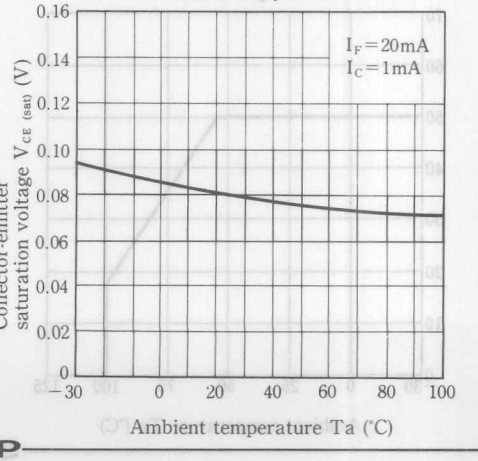


Fig. 9 Collector Dark Current vs. Ambient Temperature

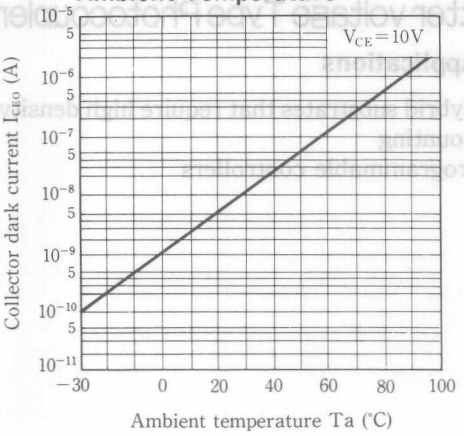
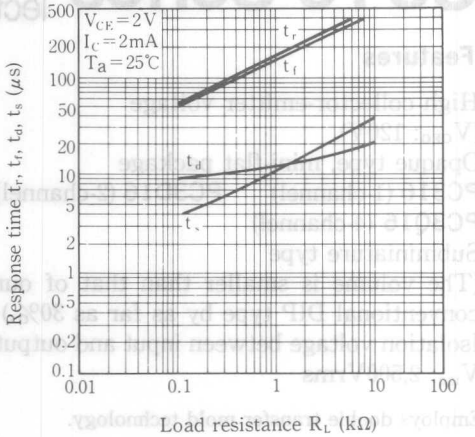


Fig. 10 Response Time vs. Load Resistance



Test Circuit for Response Time

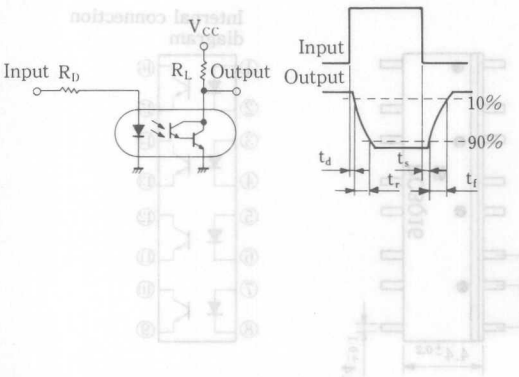
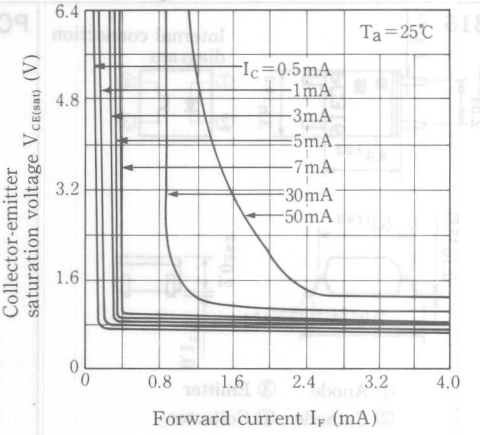


Fig. 11 Collector-emitter Saturation Voltage vs. Forward Current



Package Specification of PC300 Series (1-ch type)

Model No.	Sales Unit	Package Specifications	Diameter of Reel	Tape Width
PC3＊＊Z	1 pc.	Sleeve package (Net: 125 pcs.)	—	—
PC3＊＊	3,000 pcs.	Taping package (Net: 3,000 pcs.)	φ370mm	12mm
PC3＊＊T	750 pcs.	Taping package (Net: 750 pcs.)	φ178mm	12mm

6

PC316 Series Opaque*, Mini-Flat Package, High Collector-emitter voltage Type Photocoupler

■ Features

1. High collector-emitter voltage (V_{CEO}: 120V)
2. Opaque type, mini-flat package
   PC316 (1-channel) PC3D16 (2-channel)
   PC3Q16 (4-channel)
3. Subminiature type
   (The volume is smaller than that of our conventional DIP type by as far as 30%.)
4. Isolation voltage between input and output V_{iso}: 2,500Vrms

* Employs double transfer mold technology.

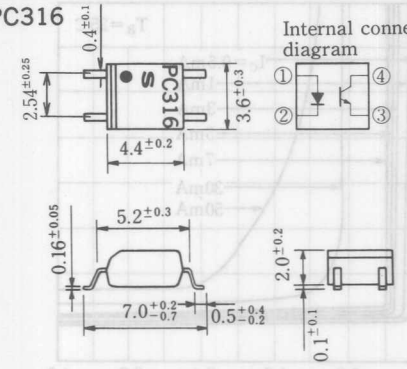
■ Applications

1. Hybrid substrates that require high density mounting
2. Programmable controllers

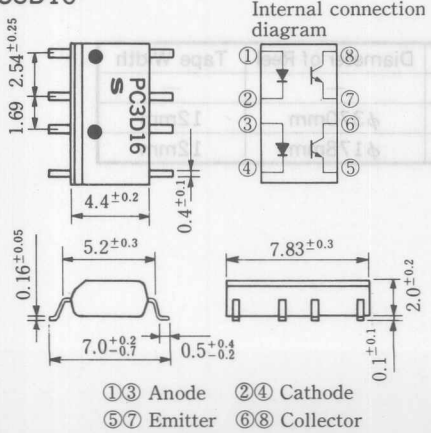
■ Outline Dimensions

(Unit : mm)

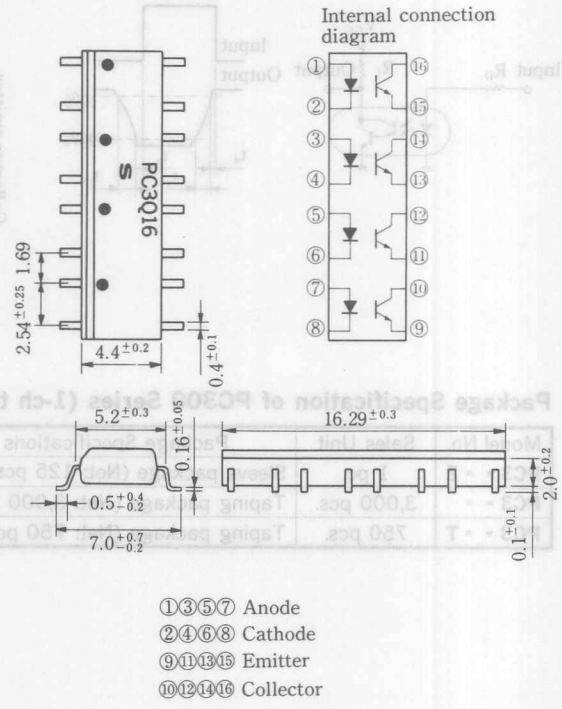
PC316



PC3D16



PC3Q16



■ Absolute Maximum Ratings

(Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	120	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
	Total power dissipation	P_{tot}	170	mW
	*2Isolation voltage	V_{iso}	2,500	Vrms
	Operating temperature	T_{opr}	−30～+100	°C
	Storage temperature	T_{stg}	−40～+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	50	100	600	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{iso}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	4	18	μs
	Response time (Fall)	t_f	R_L=100Ω	—	3	18	μs

Fig. 1 Forward Current vs. Ambient Temperature

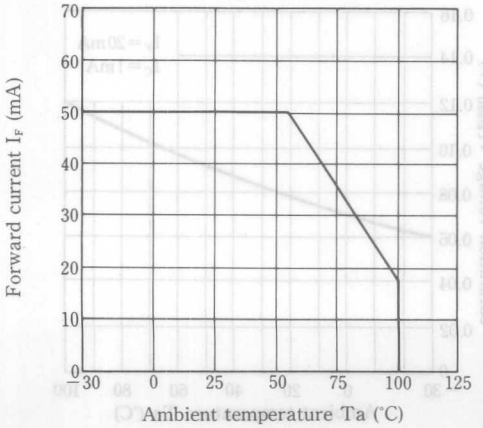
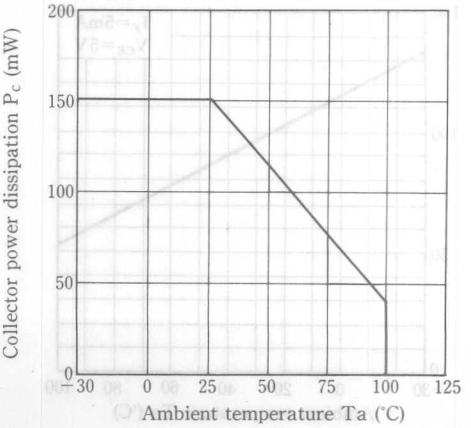


Fig. 2 Collector Power Dissipation vs. Ambient Temperature



6

Fig. 3 Peak Forward Current vs. Duty Ratio

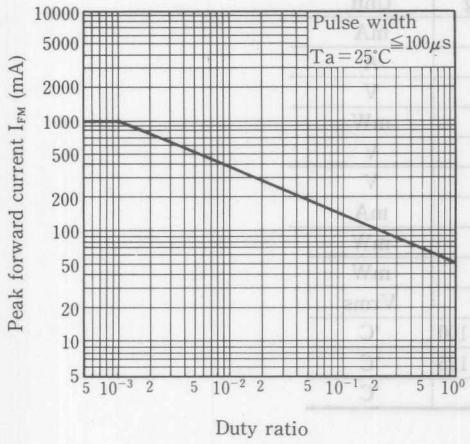


Fig. 4 Forward Current vs. Forward Voltage

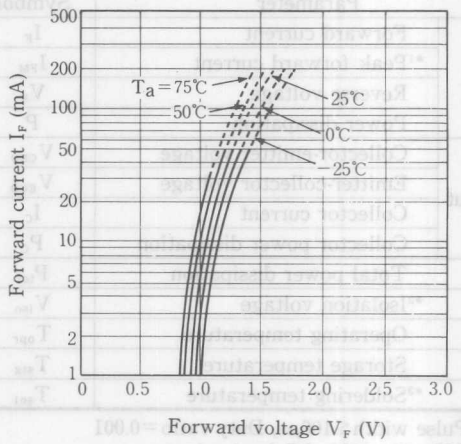


Fig. 5 Current Transfer Ratio vs. Forward Current

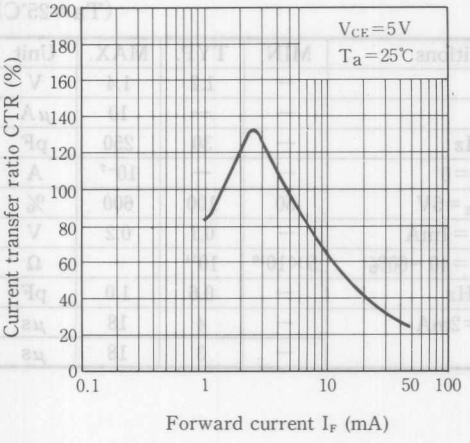


Fig. 6 Collector Current vs. Collector-emitter Voltage

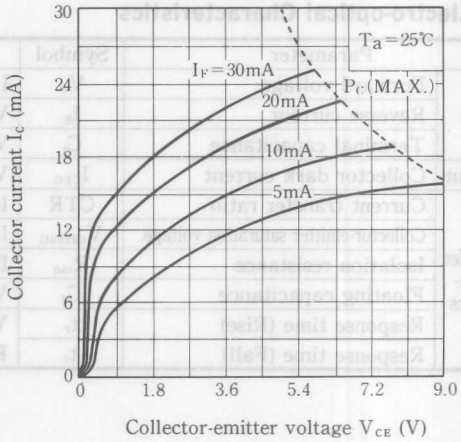


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

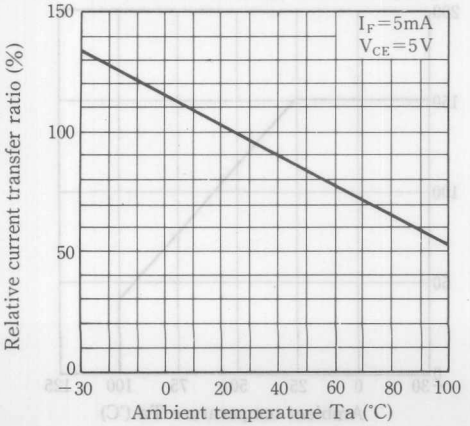


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

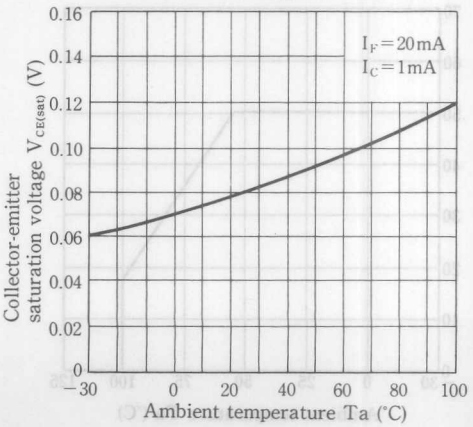


Fig. 9 Collector Dark Current vs. Ambient Temperature

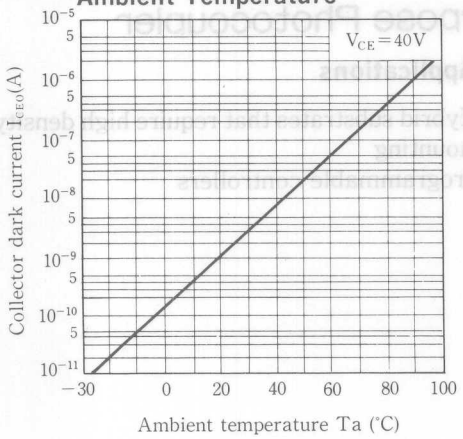
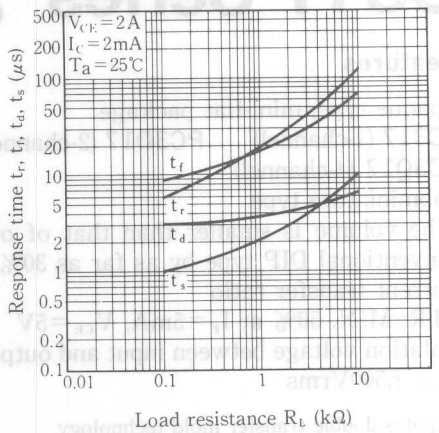


Fig. 10 Response Time vs. Load Resistance



Test Circuit for Response Time

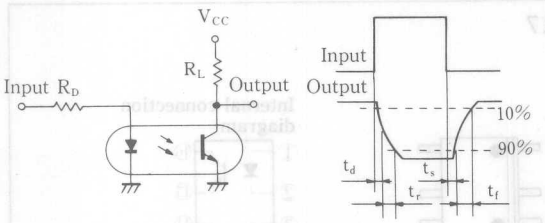
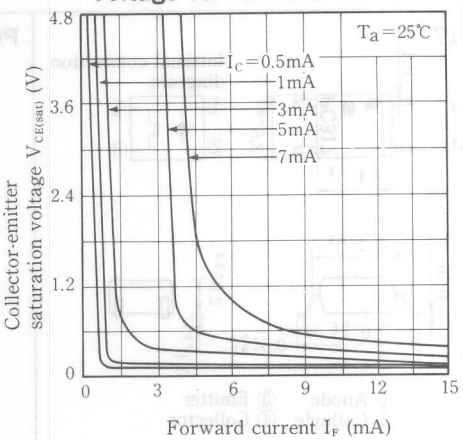


Fig. 11 Collector-emitter Saturation Voltage vs. Forward Current



Package Specification of PC300 Series (1-ch type)

Model No.	Sales Unit	Package Specifications	Diameter of Reel	Tape Width
PC3＊＊Z	1 pc.	Sleeve package (Net: 125 pcs.)	—	—
PC3＊＊	3,000 pcs.	Taping package (Net: 3,000 pcs.)	φ370mm	12mm
PC3＊＊T	750 pcs.	Taping package (Net: 750 pcs.)	φ178mm	12mm

6

PC317 Series Opaque*, Mini-Flat Package, General Purpose Photocoupler

■ Features

1. Opaque type, mini-flat package
   PC317 (1-channel) PC3D17 (2-channel)
   PC3Q17 (4-channel)
2. Subminiature type
   (The volume is smaller than that of our conventional DIP type by as far as 30%.)
3. Current transfer ratio
   CTR: MIN. 50% at I_F=5mA, V_{CE}=5V
4. Isolation voltage between input and output
   V_{iso}: 2,500Vrms

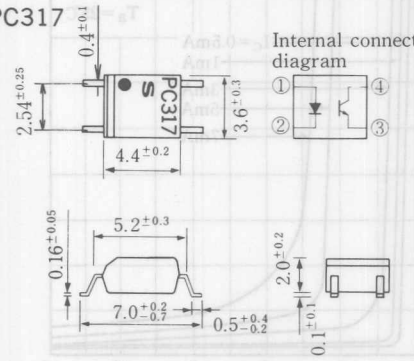
* Empolys double transfer mold technology.

■ Applications

1. Hybrid substrates that require high density mounting
2. Programmable controllers

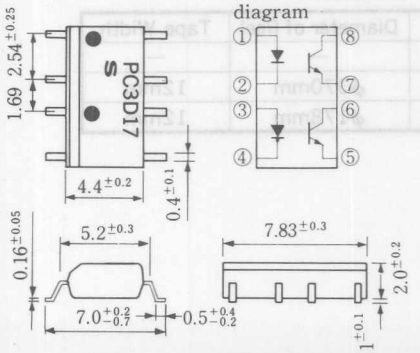
■ Outline Dimensions (Unit : mm)

PC317



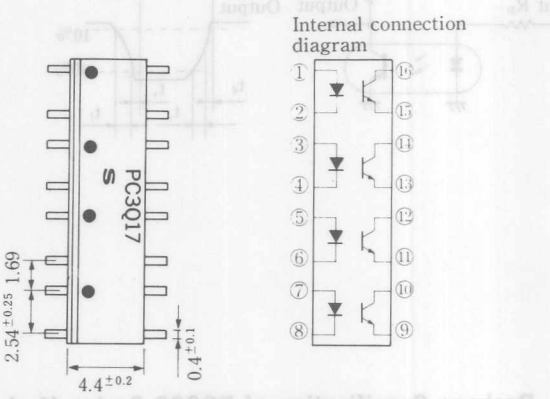
① Anode ③ Emitter
② Cathode ④ Collector

PC3D17



①③ Anode ②④ Cathode
⑤⑦ Emitter ⑥⑧ Collector

PC3Q17



①③⑤⑦ Anode
②④⑥⑧ Cathode
⑨⑪⑬⑮ Emitter
⑩⑫⑭⑯ Collector

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
	Total power dissipation	P_{tot}	170	mW
	*2Isolation voltage	V_{iso}	2,500	Vrms
	Operating temperature	T_{opr}	−30～+100	°C
	Storage temperature	T_{stg}	−40～+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

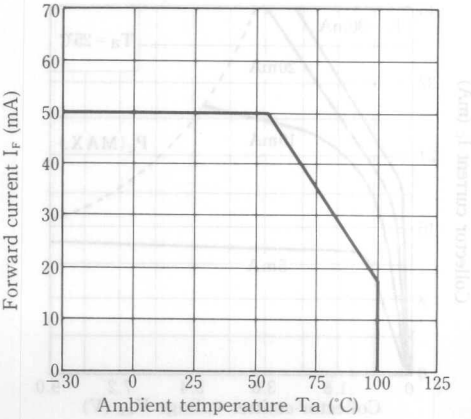
■ Electro-optical Characteristics (Ta=25°C)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	I_F=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	*4Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	50	100	600	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	4	18	μs
	Response time (Fall)	t_f	R_L=100Ω	—	3	18	μs

*4 Classification table of current transfer ratio is shown below.

	CTR(%)
PC317A	80～160
PC317B	130～260
PC317C	200～400
PC317D	300～600
PC317AB	80～260
PC317BC	130～400
PC317CD	200～600
PC317AC	80～400
PC317BD	130～600
PC317AD	80～600
PC317	50～600

Fig. 1 Forward Current vs. Ambient Temperature



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Fig. 2 Collector Power Dissipation vs. Ambient Temperature

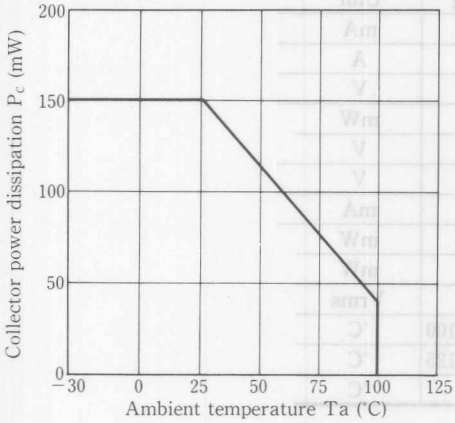


Fig. 3 Peak Forward Current vs. Duty Ratio

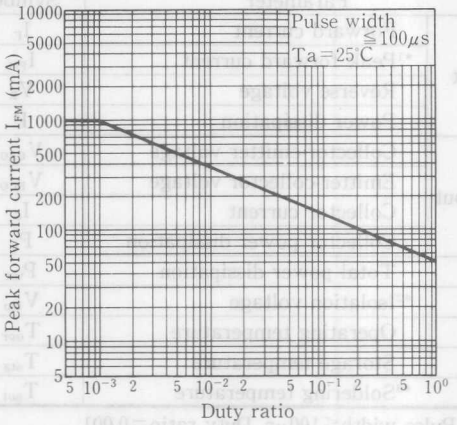


Fig. 4 Forward Current vs. Forward Voltage

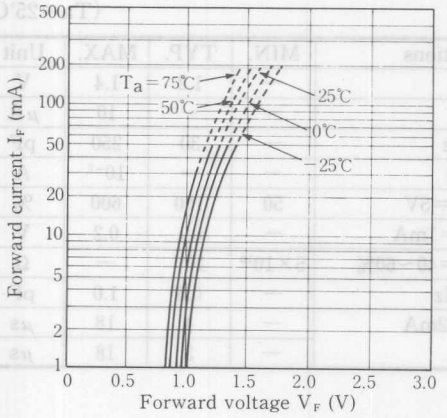


Fig. 5 Current Transfer Ratio vs. Forward Current

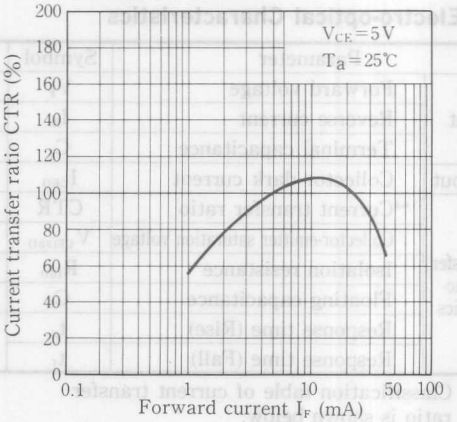


Fig. 6 Collector Current vs. Collector-emitter Voltage

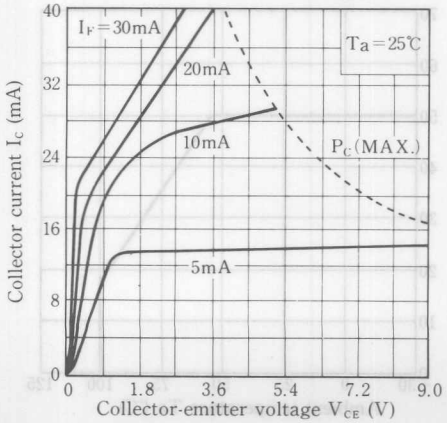


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

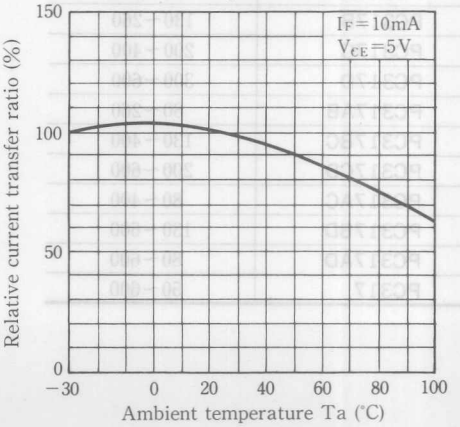


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

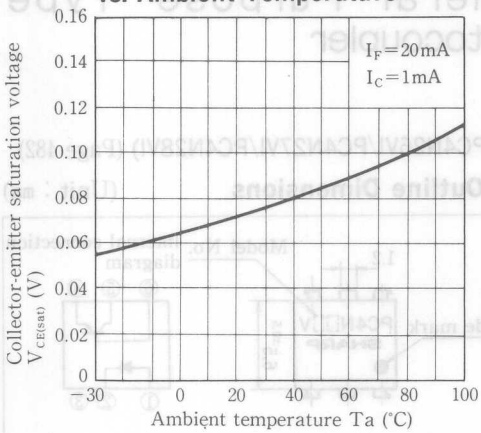


Fig. 9 Collector Dark Current vs. Ambient Temperature

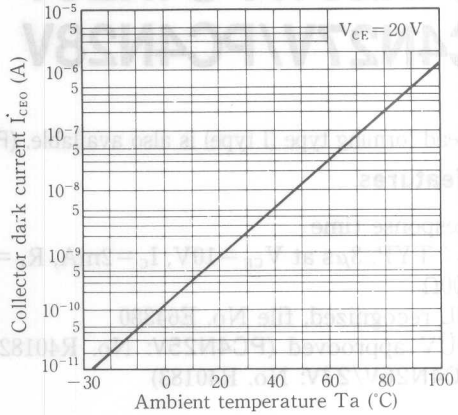


Fig. 10 Response Time vs. Load Resistance

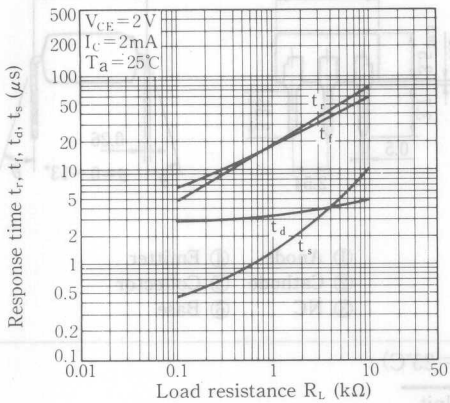
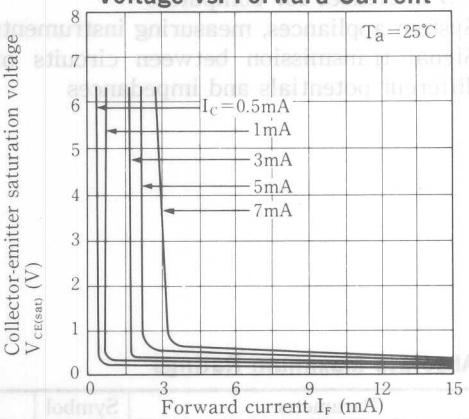
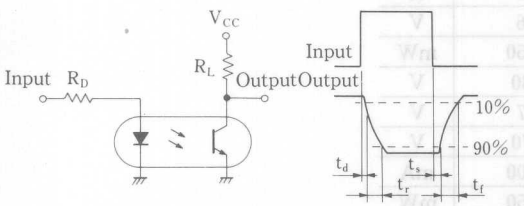


Fig. 11 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Response Time



Package Specification of PC300 Series (1-ch type)

Model No.	Sales Unit	Package Specifications	Diameter of Reel	Tape Width
PC3＊＊Z	1 pc.	Sleeve package (Net: 125 pcs.)	—	—
PC3＊＊	3,000 pcs.	Taping package (Net: 3,000 pcs.)	ϕ370mm	12mm
PC3＊＊T	750 pcs.	Taping package (Net: 750 pcs.)	ϕ178mm	12mm

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PC4N25V/PC4N26V PC4N27V/PC4N28V

General Purpose Type Photocoupler

※ Lead forming type (I type) is also available. (PC4N25VI/PC4N26VI/PC4N27VI/PC4N28VI) (Page 482)

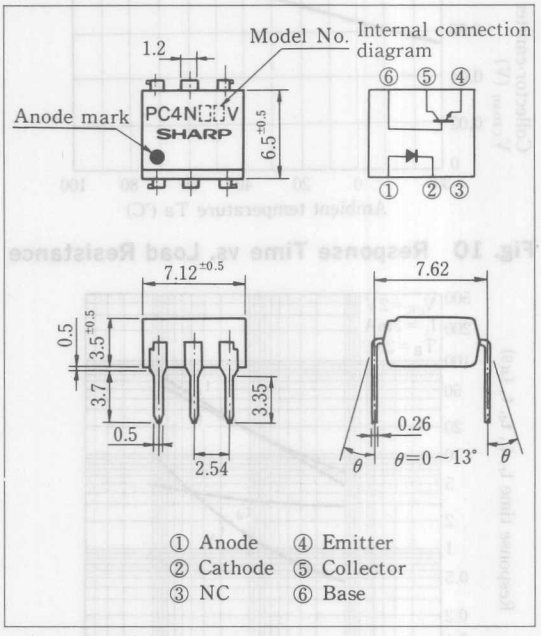
■ Features

1. Response time
   t_r : TYP. 3μs at V_{CE}=10V, I_C=2mA, R_L=100Ω
2. UL recognized, file No. E64380
   TÜV approoved (PC4N25V: No. R40182, PC4N26V/27V: No. R40183)

■ Applications

1. I/O interfaces for computers
2. System appliances, measuring instruments
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter			Symbol	Rating	Unit
Input	Forward current		I_F	80	mA
	*1Peak forward current		I_{FM}	3	A
	Reverse voltage		V_R	6	V
	Power dissipation		P	150	mW
Output	Collector-emitter voltage		V_{CEO}	30	V
	Emitter-collector voltage		V_{ECO}	7	V
	Collector-base voltage		V_{CBO}	70	V
	Collector current		I_C	100	mA
	Collector power dissipation		P_C	150	mW
Total power dissipation			P_{tot}	250	mW
*2Isolation voltage		PC4N25V	V_{iso}	2500	Vrms
		PC4N26V,27V		1,500	
		PC4N28V		500	
Operating temperature			T_{opr}	−55~+100	°C
Storage temperature			T_{stg}	−55~+150	°C
*3Soldering temperature			T_{sol}	260	°C

*1 Pulse width≦1μs, Duty ratio=0.001 *3 For 10 seconds
*2 RH=40~60%, AC for 1 minute

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=10mA	—	1.2	1.5	V
	Reverse current		I_R	V_R=4V	—	—	10	μA
	Terminal capacitance		C_t	V=0, f=1kHz	—	50	—	pF
Output	Collector dark current	PC4N25V~27V	I_{CEO}	V_{CE}=10V	—	—	5×10^{-8}	A
		PC4N28V		I_F=0	—	—	10^{-7}	
	Collector-emitter breakdown voltage		BV_{CEO}	I_C=0.1mA, I_F=0	30	—	—	V
	Emitter-collector breakdown voltage		BV_{ECO}	I_E=10μA, I_F=0	7	—	—	V
	Collector-base breakdown voltage		BV_{CBO}	I_C=0.1mA, I_F=0	70	—	—	V
Transfer characteristics	Current transfer ratio	PC4N25V,26V	CTR	I_F=10mA, V_{CE}=10V Pulse test : input width=300μs, duty ratio≦0.02	20	—	—	%
		PC4N27V,28V			10	—	—	
	Collector-emitter saturation voltage		$V_{CE(sat)}$	I_F=50mA, I_C=2mA	—	0.1	0.5	V
	Isolation resistance		R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance		C_f	V=0, f=1MHz	—	1.0	—	PF
	Response time (Rise)		t_r	V_{CE}=10V, I_C=2mA	—	3	—	μs
	Response time (Fall)		t_f	R_L=100Ω, R_{BE}=∞	—	3	—	μs

Fig. 1 Forward Current vs. Ambient Temperatumre

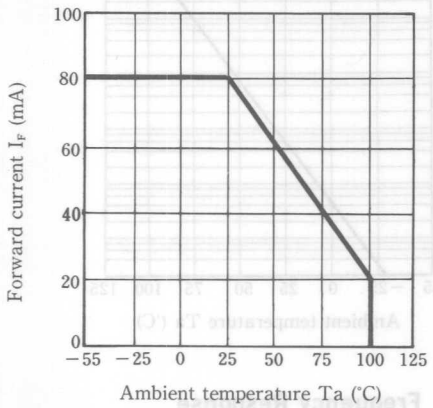


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

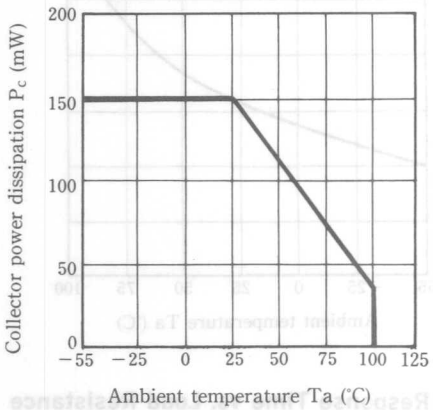


Fig. 3 Forward Current vs. Forward Voltage

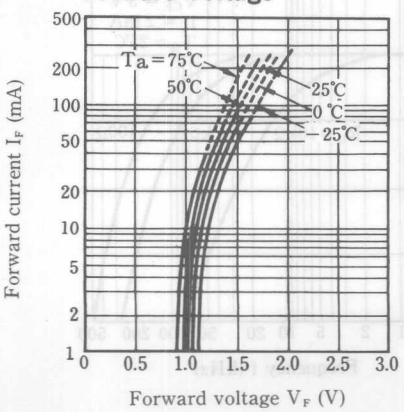
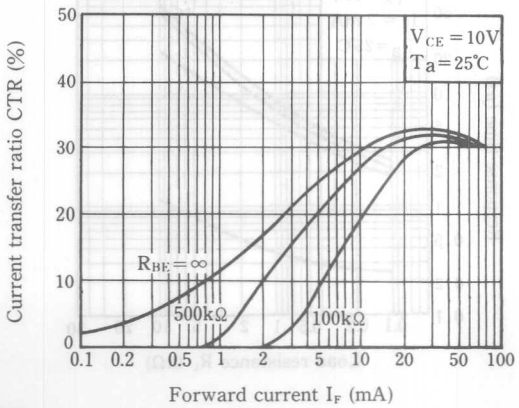


Fig. 4 Current Transfer Ratio vs. Forward Current



6

Fig. 5 Collecter Current vs. Collecter-emitter Voltage

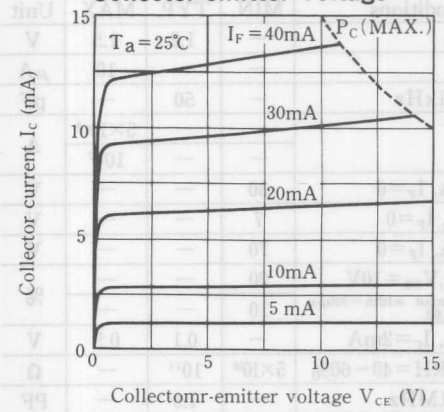


Fig. 6 Relative Current Transfer Ratio vs. Ambient Temperature

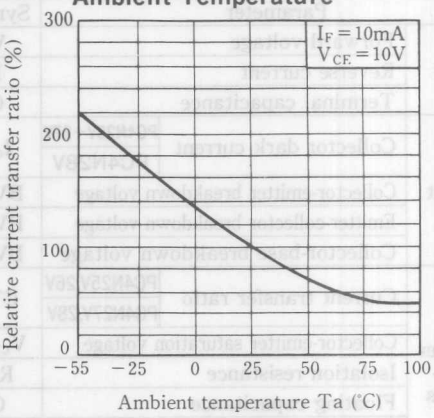


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

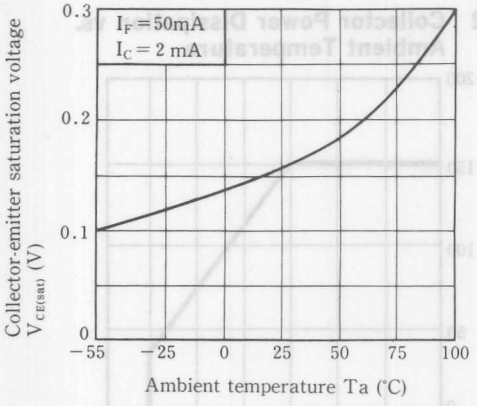


Fig. 8 Collector Dark Current vs. Ambient Temperature

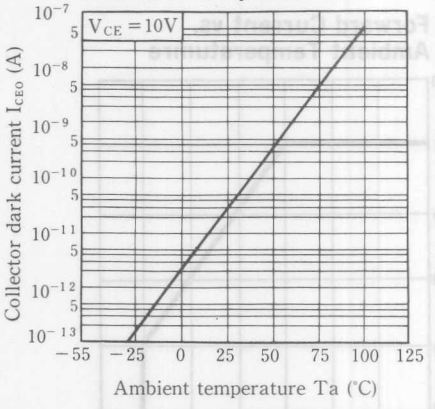


Fig. 9 Response Time vs. Load Resistance

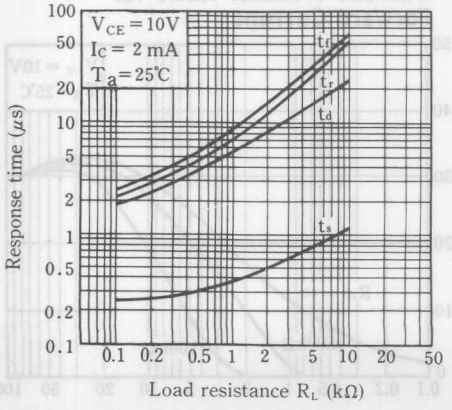


Fig. 10 Frequency Response

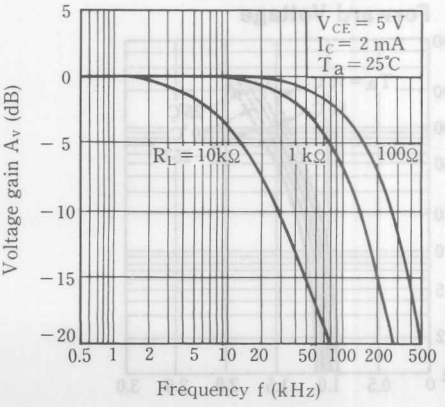
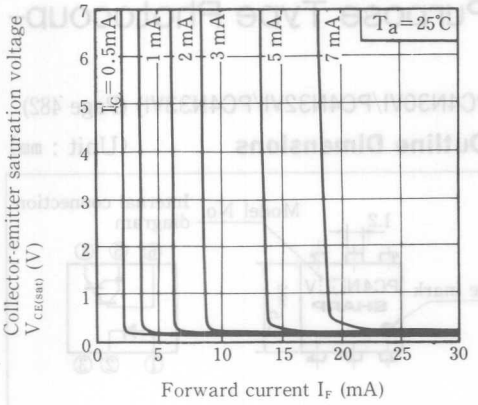
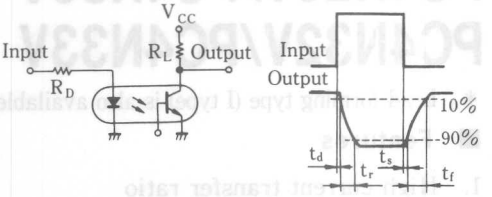


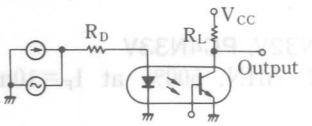
Fig. 11 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Response Time



Test Circuit for Frequency Response



6

PC4N29V/PC4N30V PC4N32V/PC4N33V

High Transfer Efficiency, General Purpose Type Photocoupler

* Lead forming type (I type) is also available. (PC4N29VI/PC4N30VI/PC4N32VI/PC4N33VI) (Page 482)

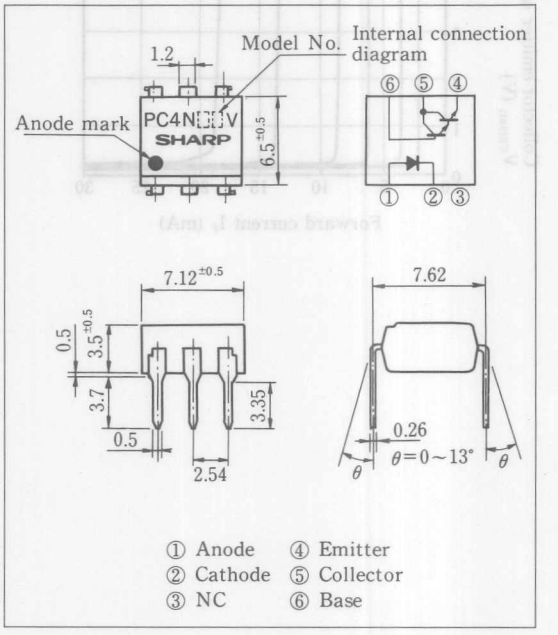
■ Features

1. High current transfer ratio
   PC4N29V, PC4N30V
   (CTR : MIN. 100% at I_F=10mA, V_{CE}=10V)
   PC4N32V, PC4N33V
   (CTR : MIN. 500% at I_F=10mA, V_{CE}=10V)
2. Response time t_{on} : MAX. 5μs at I_F=200mA, V_{CC}=10V, I_C=50mA
3. UL recognized, file No. E64380
   TÜV approved, **PC4N29V/32V** : No. R40184, **PC4N30V/33V** : No. R40185

■ Applications

1. I/O interfaces for computers
2. System appliances, measuring instruments
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter			Symbol	Rating	Unit
Input	Forward current		I_F	80	mA
	*1Peak forward current		I_{FM}	3	A
	Reverse voltage		V_R	6	V
	Power dissipation		P	150	mW
Output	Collector-emitter voltage		V_{CEO}	30	V
	Emitter-collector voltage		V_{ECO}	5	V
	Collector-base voltage		V_{CBO}	30	V
	Collector current		I_C	100	mA
	Collector power dissipation		P_C	150	mW
Total power dissipation			P_{tot}	250	mW
*2 Isolation voltage		PC4N29V,32V	V_{iso}	2,500	Vrms
		PC4N30V,33V		1,500	
Operating temperature			T_{opr}	−55~+100	°C
Storage temperature			T_{stg}	−55~+150	°C
*3Soldering temperature			T_{sol}	260	°C

*1 Pulse width≦1μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=10mA	—	1.2	1.5	V
	Reverse current		I_R	V_R=4V	—	—	10	μA
	Terminal capacitance		C_t	V=0, f=1kHz	—	50	—	pF
Output	Collector dark current		I_{CEO}	V_{CE}=10V, I_F=0	—	—	10^{-7}	A
	Collector-emitter breakdown voltage		BV_{CEO}	I_C=0.1mA, I_F=0	30	—	—	V
	Emitter-collector breakdown voltage		BV_{ECO}	I_E=10μA, I_F=0	5	—	—	V
	Collector-base breakdown voltage		BV_{CBO}	I_C=0.1mA, I_F=0	30	—	—	V
Transfer characteristics	Current transfer ratio	PC4N29V,30V	CTR	I_F=10mA, V_{CE}=10V Pulse test : input pulse width=300μs, duty ratio≦0.02	100	—	—	%
		PC4N32V,33V			500	—	—	
	Collector-emitter saturation voltage		$V_{CE(sat)}$	I_F=8mA, I_C=2mA	—	—	1.0	V
	Isolation resistance		R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance		C_f	V=0, f=1MHz	—	1.0	—	pF
	Response time (Turn-on time)		t_{on}	I_F=200mA	—	—	5	μs
	Response time (Turn-off time)	PC4N29V,30V	t_{off}	(t_W≃1.0ms)	—	—	40	μs
		PC4N32V,33V		V_{CC}=10V, I_C=50mA	—	—	100	μs

Fig. 1 Forward Current vs. Ambient Temperature

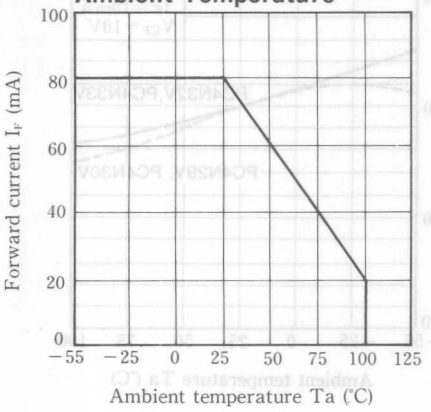


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

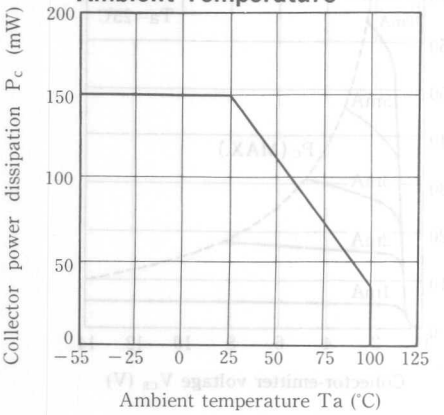


Fig. 3 Forward Current vs. Forward Voltage

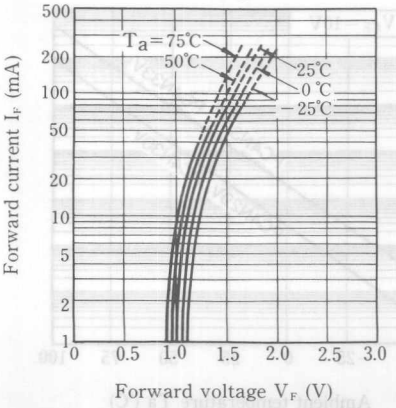
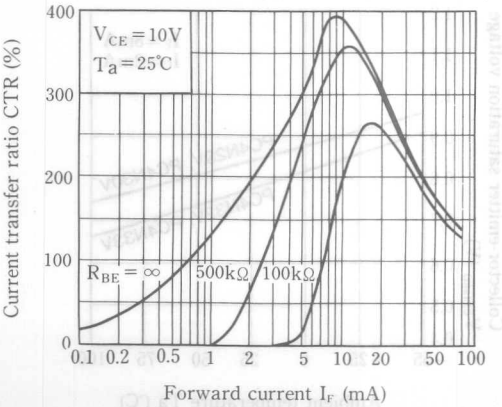


Fig. 4 Current Transfer Ratio vs. Forward Current (PC4N29V, PC4N30V)



6

Fig. 5 Current Transfer Ratio vs. Forward Current (PC4N32V, PC4N33V)

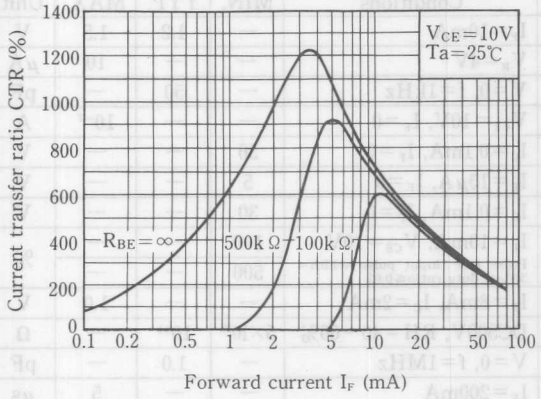


Fig. 6 Collector Current vs. Collector-emitter Voltage (PC4N29V, PC4N30V)

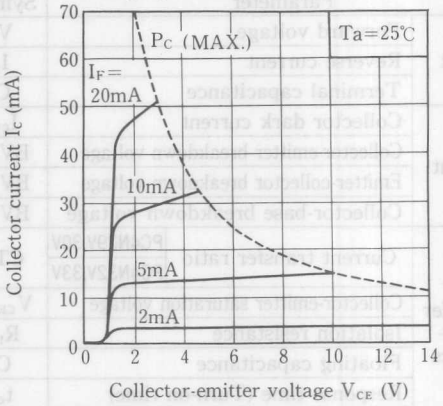


Fig. 7 Collector Current vs. Collector-emitter Voltage (PC4N32V, PC4N33V)

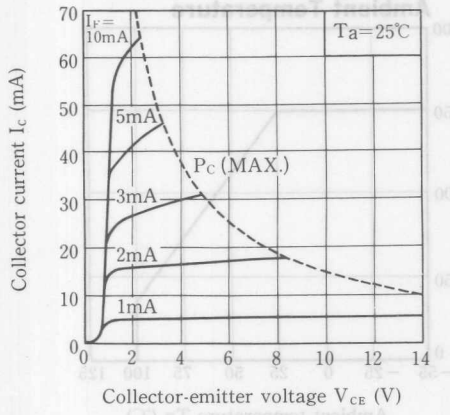


Fig. 8 Relative Current Transfer Ratio vs. Ambient Temperature

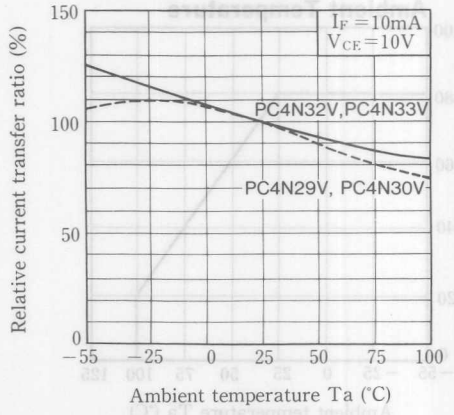


Fig. 9 Collector-emitter Saturation Voltage vs. Ambient Temperature

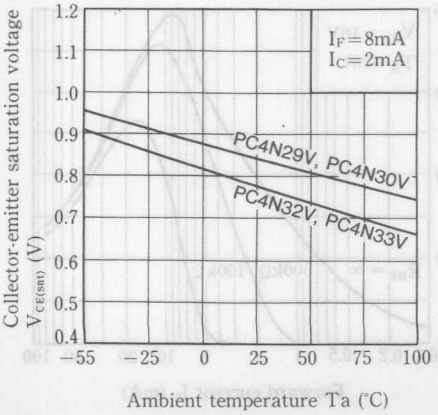


Fig. 10 Collector Dark Current vs. Ambient Temperature

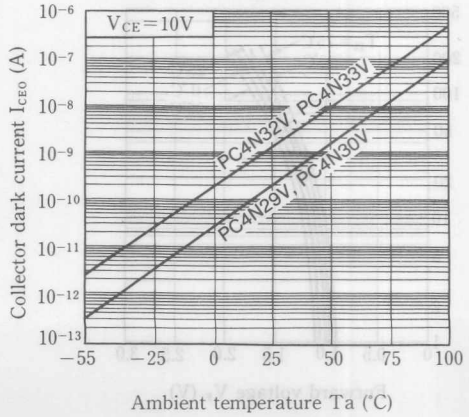


Fig. 11 Frequency Response (PC4N29V, PC4N30V)

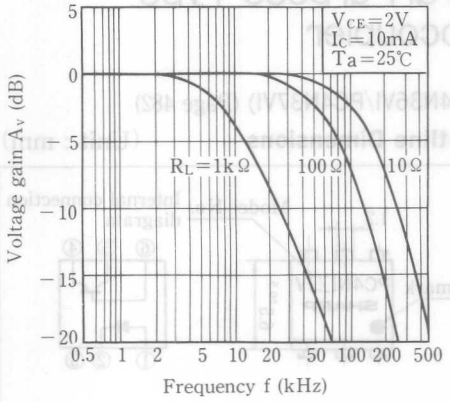


Fig. 12 Frequency Response (PC4N32V, PC4N33V)

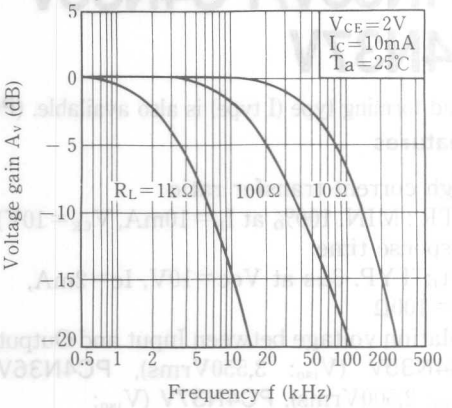


Fig. 13 Collector-emitter Saturation Voltage vs. Forward Current (PC4N29V, PC4N30V)

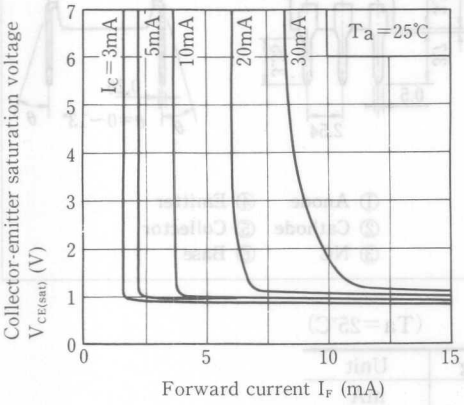
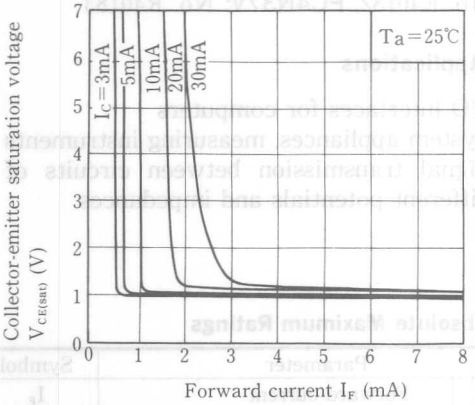
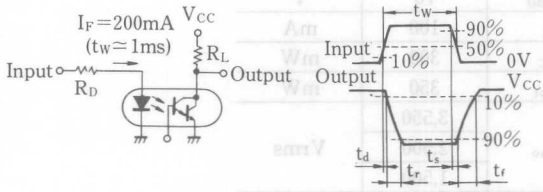


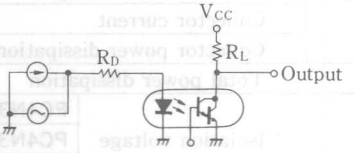
Fig. 14 Collector-emitter Saturation Voltage vs. Forward Current (PC4N32V, PC4N33V)



Test Circuit for Response Time



Test Circuit for Frequency Response



6

PC4N35V/PC4N36V PC4N37V

General Purpose Type Photocoupler

※ Lead forming type (I type) is also available. (PC4N35VI/PC4N36VI/PC4N37VI) (Page 482)

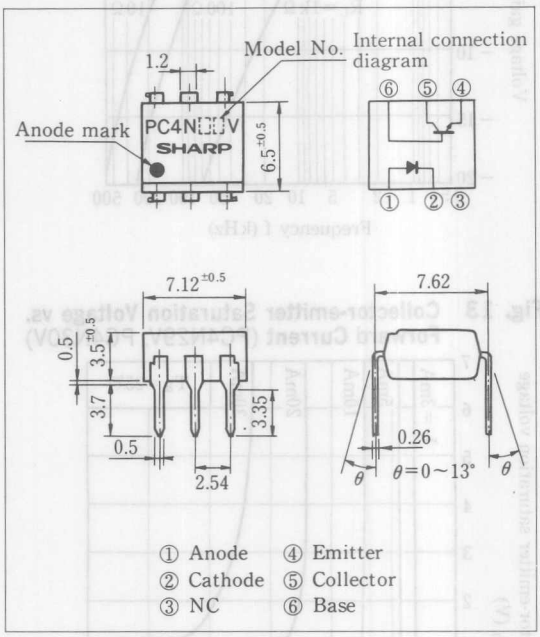
■ Features

1. High current transfer ratio (CTR : MIN. 100% at I_F=10mA, V_{CE}=10V)
2. Response time t_r, t_f: TYP. 3μs at Vcc=10V, Ic=2mA, R_L=100Ω
3. Isolation voltage between Input and Output PC4N35V (V_{iso}: 3,550Vrms), PC4N36V (V_{iso}: 2,500Vrms), PC4N37V (V_{iso}: 1,500Vrms)
4. UL recognized, file No. 64380 TÜV approved, PC4N35V/36V: No. R40182, PC4N37V: No. R40183

■ Applications

1. I/O interfaces for computers
2. System appliances, measuring instruments
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter			Symbol	Rating	Unit
Input	Forward current		I_F	60	mA
	*1Peak forward current		I_{FM}	3	A
	Reverse voltage		V_R	6	V
	Power dissipation		P	100	mW
Output	Collector-emitter voltage		V_{CEO}	30	V
	Emitter-collector voltage		V_{ECO}	7	V
	Collector-base voltage		V_{CBO}	70	V
	Collector current		I_C	100	mA
	Collector power dissipation		P_C	300	mW
Total power dissipation			P_{tot}	350	mW
*2Isolation voltage		PC4N35V	V_{iso}	3,550	Vrms
		PC4N36V		2,500	
		PC4N37V		1,500	
Operating temperature			T_{opr}	−55~+100	°C
Storage temperature			T_{stg}	−55~+150	°C
*3Soldering temperature			T_{sol}	260	°C

*1 Pulse width≦1μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=10mA	—	1.2	1.5	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1MHz	—	50	—	pF
Output	Collector darkcurrent	I_{CEO}	V_{CE}=10V	—	—	5×10^{-8}	A
			Ta=100°C, V_{CE}=30V	—	—	5×10^{-4}	A
	Collector-emitter breakdown voltage	BV_{CEO}	I_C=0.1mA, I_F=0	30	—	—	V
	Emitter-collector breakdown voltage	BV_{ECO}	I_E=10μA, I_F=0	7	—	—	V
	Collector-base breakdown voltage	BV_{CBO}	I_C=0.1mA, I_F=0	70	—	—	V
Transfer characteristics	*4Current transfer ratio	CTR	I_F=10mA, V_{CE}=10V	100	—	—	%
			Ta=−55°C, I_F=10mA, V_{CE}=10V	40	—	—	
			Ta=100°C, I_F=10mA, V_{CE}=10V	40	—	—	
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=50mA, I_C=2mA	—	—	0.3	V
	Isolation resistance	R_{ISO}	DC500V, HR=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	1.0	2.5	pF
	Response time (Rise)	t_r	V_{CC}=10V, I_C=2mA	—	3	10	μs
	Response time (Fall)	t_f	R_L=100Ω, R_{BE}=∞	—	3	10	μs

*4 Pulse test : input pulse width=300μs, duty ratio≦0.02

Fig. 1 Forward Current vs. Ambient Temperature

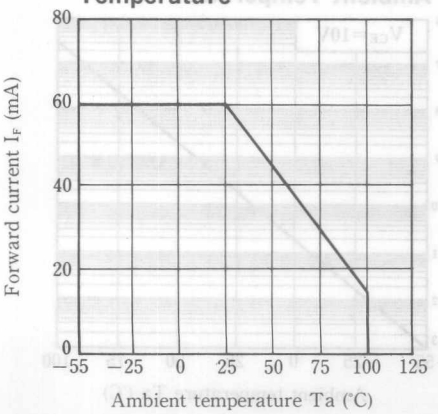
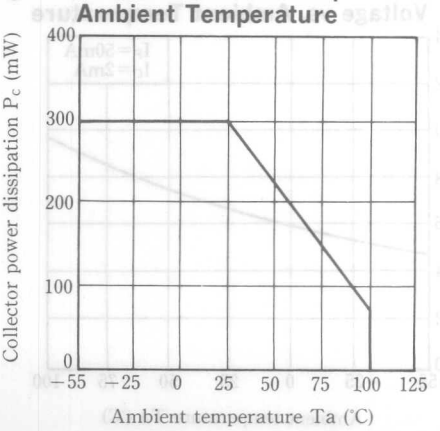


Fig. 2 Collector Power Dissipation vs. Ambient Temperature



6

Fig. 3 Forward Current vs. Forward Voltage

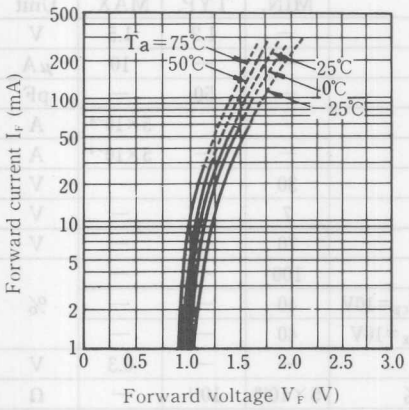


Fig. 4 Current Transfer Ratio vs. Forward Current

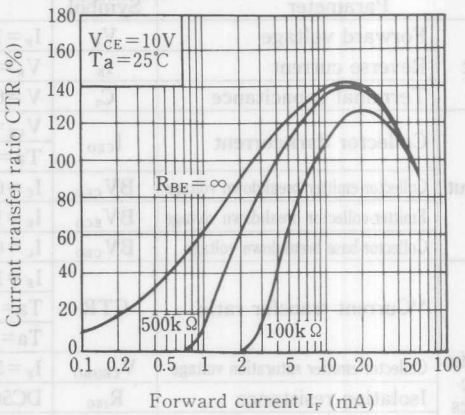


Fig. 5 Collector Current vs. Collector-emitter Voltage (Ta=25°C)

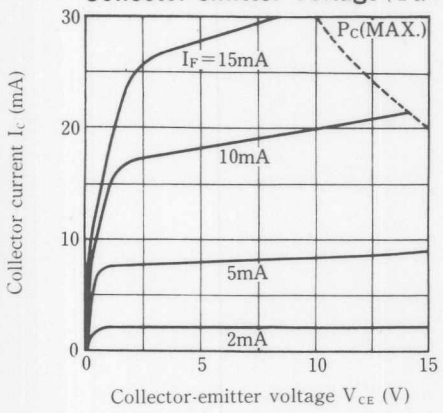


Fig. 6 Relative Current Transfer Ratio vs. Ambient Temperature

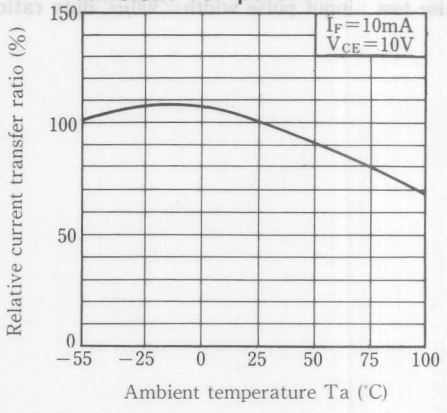


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

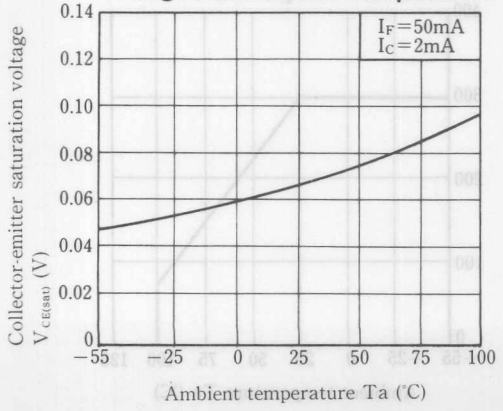


Fig. 8 Collector Dark Current vs. Ambient Temperature

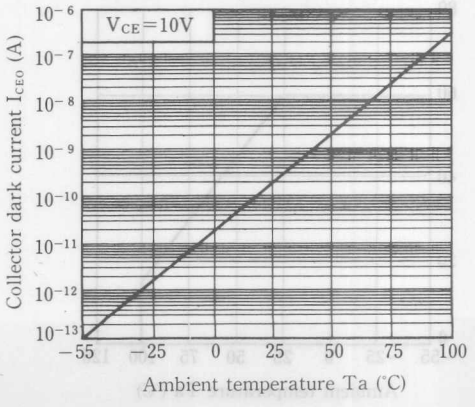


Fig. 9 Response Time vs. Load Resistance

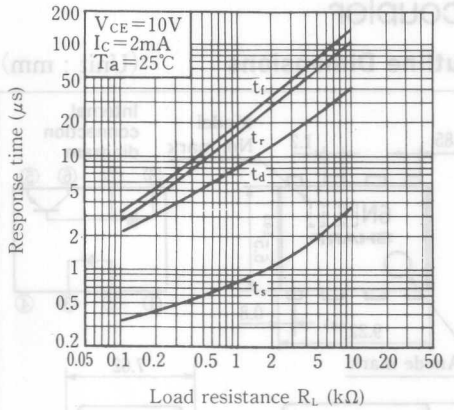


Fig. 10 Frequency Response

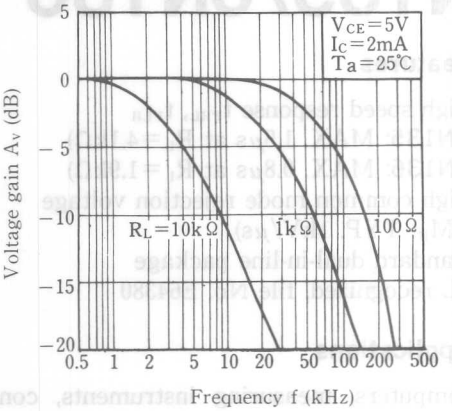
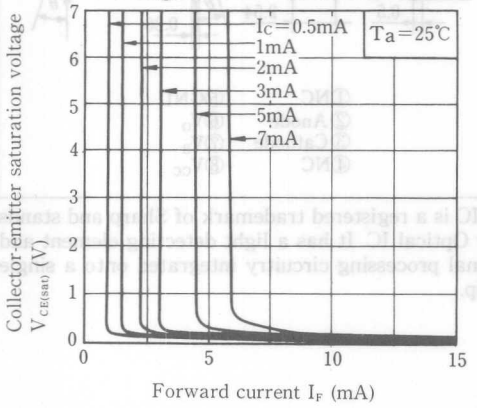
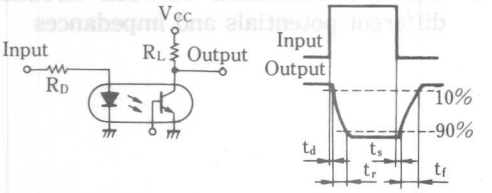


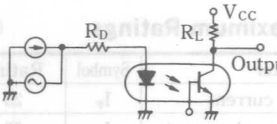
Fig. 11 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Response Time



Test Circuit for Frequency Response



6

6N135/6N136 General Purpose Type Photocoupler

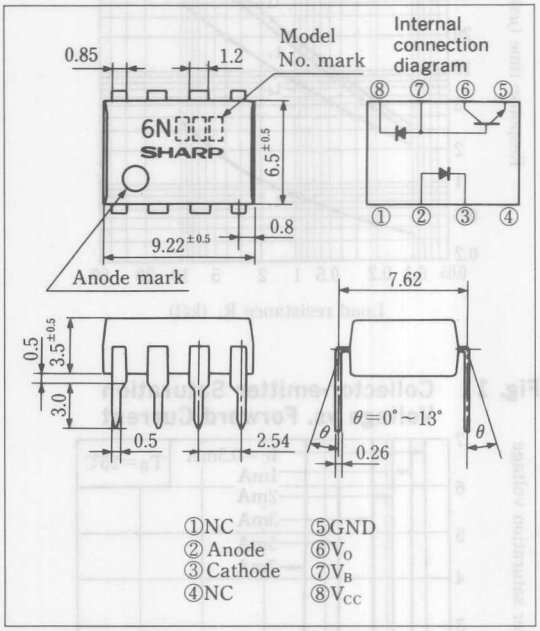
■ Features

1. High speed response t_{PHL}, t_{PLH}
   (6N135: MAX. 1.5μs at R_L=4.1kΩ)
   (6N136: MAX. 0.8μs at R_L=1.9kΩ)
2. High common mode rejection voltage
   (CM_H: TYP. 1kV/μs)
3. Standard dual-in-line package
4. UL recognized, file No. E64380

■ Applications

1. Computers, measuring instruments, control equipment
2. High speed line receivers, high speed logic
3. Telephone sets
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	25	mA
	*1Peak forward current	I_F	50	mA
	*2Peak transient forward current	I_{FM}	1	A
	Reverse voltage	V_R	5	V
	Power dissipation	P	45	mW
Output	Supply voltage	V_{CC}	−0.5~+15	V
	Output voltage	V_O	−0.5~+15	V
	Emitter-base reverse withstand voltage (Pin 5~7)	V_{EBO}	5	V
	Average output current	I_O	8	mA
	Peak output current	I_{OP}	16	mA
	Base current (Pin 7)	I_B	5	mA
	Power dissipation	P_O	100	mW
*3Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	−55~+100	°C
Storage temperature		T_{stg}	−55~+125	°C
*4Soldering temperature		T_{sol}	260	°C

*1 50% duty cycle, Pulse width=1ms
Decreases at the rate of 1.6mA/°C if the external temperature is 70°C or more.
*2 Pulse width≦1μs, 300P/s
*3 RH=40~60%, AC for 1 minute
*4 For 10 seconds

■ Electro-optical Characteristics

(T_a=0~70°C unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*5Current transfer ratio	6N135	CTR(1)	Ta=25°C, I_F=16mA	7.0	40	—	%
	6N136	CTR(1)	V_O=0.4V, V_{CC}=4.5V	19	40	—	%
	6N135	CTR(2)	I_F=16mA, V_O=0.5V	5.0	43	—	%
	6N136	CTR(2)	V_{CC}=4.5V	15	43	—	%
Logic (0) output voltage		V_{OL}	*7I_F=16mA, V_{CC}=4.5V	—	0.1	0.4	V
Logic (1) output current		I_{OH}(1)	T_a=25°C, I_F=0 V_{CC}=V_O=5.5V	—	3.0	500	nA
		I_{OH}(2)	T_a=25°C, I_F=0 V_{CC}=V_O=15V	—	0.01	1.0	μA
		I_{OH}(3)	I_F=0, V_{CC}=V_O=15V	—	—	50	μA
Logic (0) supply current		I_{CCL}	I_F=16mA, V_{CC}=15V V_O=open	—	200	—	μA
Logic (1) supply current		I_{CCH}(1)	T_a=25°C, V_{CC}=15V V_O=open, I_F=0	—	0.02	1.0	μA
		I_{CCH}(2)	V_{CC}=15V V_O=open, I_F=0	—	—	2.0	μA
Input forward voltage		V_F	T_a=25°C, I_F=16mA	—	1.7	1.95	V
Input forward voltage temperture coefficient		$\Delta V_F/\Delta T_a$	I_F=16mA	—	−1.9	—	mV/°C
Input reverse voltage		BV_R	T_a=25°C, I_R=10μA	5.0	—	—	V
Input capacitance		C_{IN}	V_F=0, f=1MHz	—	60	—	PF
*6Leak current (input-output)		I_{I-O}	T_a=25°C, RH=45%, t=5s V_{I-O}=3kVDC	—	—	1.0	μA
*6Isolation resistance (input-output)		R_{I-O}	V_{I-O}=500VDC	—	10^{12}	—	Ω
*6Capacitance (input-output)		C_{I-O}	f=1MHz	—	0.6	—	PF
Transistor current amplification factor		h_{FE}	V_O=5V, I_O=3mA	—	70	—	

*5 Current transfer ratio is the ratio of input current and output current expressed in %.

*6 Measured as 2-pin element (Short 1,2,3,4 and 5,6,7,8)

*7 6N135 : I_O=1.1mA, 6N136 : I_O=2.4mA

Note) Typical value : at Ta=25°C

6

■ Switching Characteristics

(Ta=25°C, V_{CC}=5V, I_F=16mA)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*8Propagation *9delay time Output (1)→(0)	6N135	t_{PHL}	R_L=4.1kΩ	—	0.3	1.5	μs
	6N136	t_{PHL}	R_L=1.9kΩ	—	0.3	0.8	μs
*8Propagation *9delay time Output (0)→(1)	6N135	t_{PLH}	R_L=4.1kΩ	—	0.4	1.5	μs
	6N136	t_{PLH}	R_L=1.9kΩ	—	0.3	0.8	μs
*10,11Instantaneous common mode rejection voltage "output (1)"		CM_H	*12I_F=0, V_{CM}=10V_{P-P}	—	1000	—	V/μs
*10,11Instantaneous common mode rejection voltage "output (0)"		CM_L	*12V_{CM}=10V_{P-P}, I_F=16mA	—	−1000	—	V/μs
*13Bandwidth		BW	R_L=100Ω	—	2.0	—	MHz

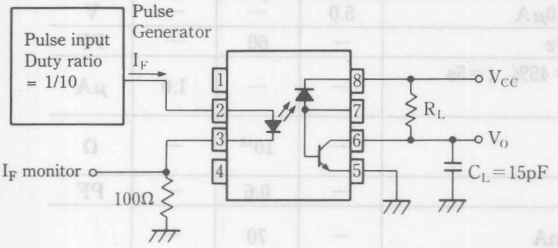
*8 R_L=4.1kΩ is equivalent to one LSTTL and 6.1kΩ pull-up resistor.

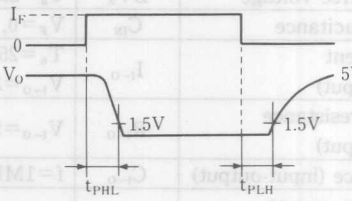
*10 Instantaneous common mode rejection voltage "output (1) " represents a common mode voltage variation that can hold the output above (1) level (V_O>2.0V). Instantaneous common mode rejection voltage "output (0)" represents a common mode voltage variation that can hold the output above (0) level (V_O<0.8V).

*12 6N135 : R_L=4.1kΩ 6N136 : R_L=1.9kΩ

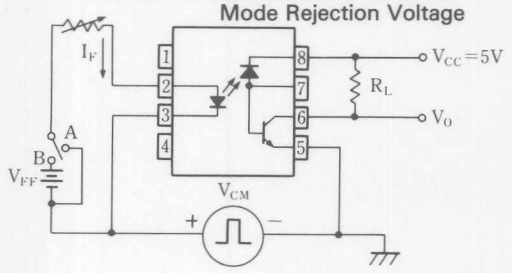
*13 Bandwidth represents a point where AC input goes down by 3dB.

*9 Test Circuit for Propagation Delay Time





*11 Test Circuit for Instantaneous Common Mode Rejection Voltage



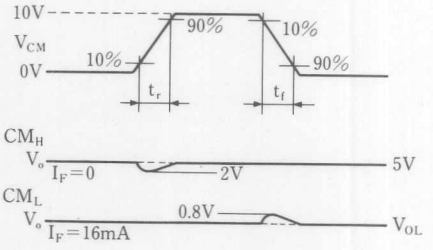


Fig. 1 Forward Current vs. Ambient Temperature

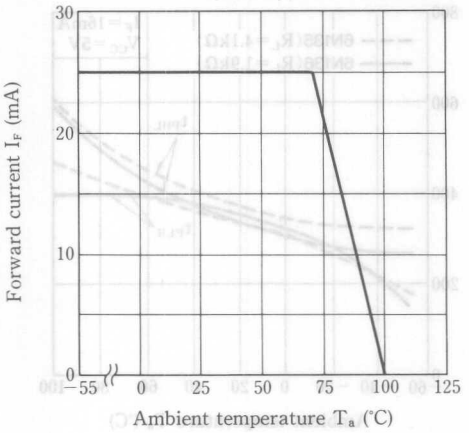


Fig. 2 Power Dissipation vs. Ambient Temperature

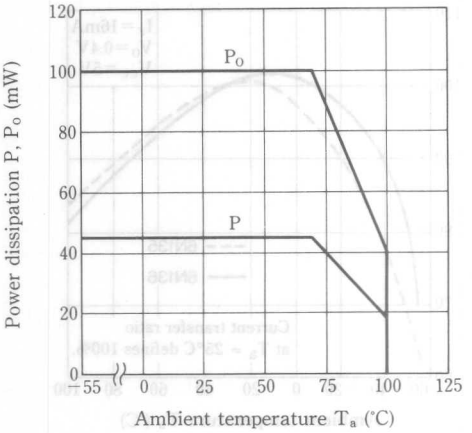


Fig. 3 Forward Current vs. Forward Voltage

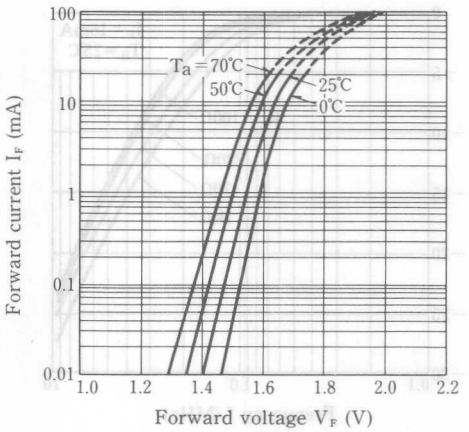


Fig. 4 Relative Current Transfer Ratio vs. Forward Current

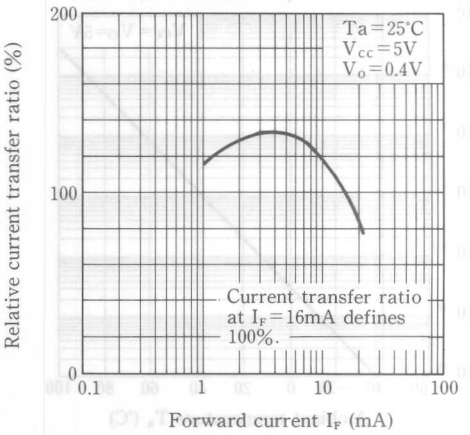
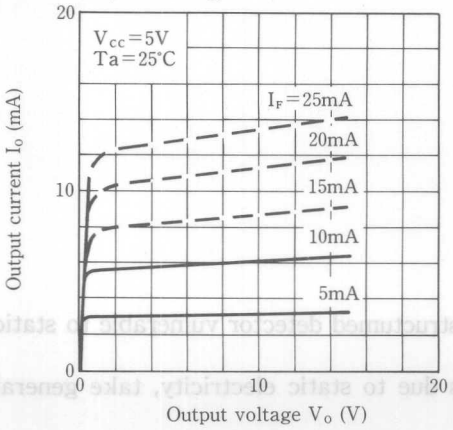


Fig. 5 Output Current vs. Output Voltage



Dotted line : driven by pulse current

Fig. 6 Relative Current Transfer Ratio vs. Ambient Temperature

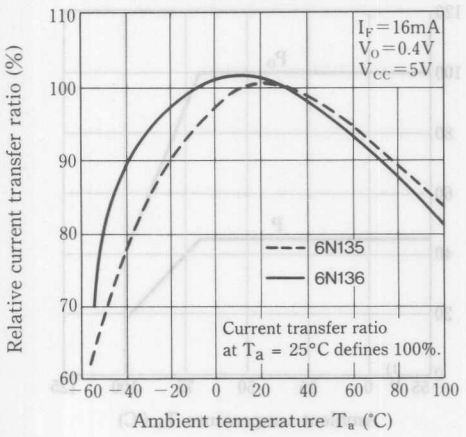


Fig. 7 Propagation Delay Time vs. Ambient Temperature

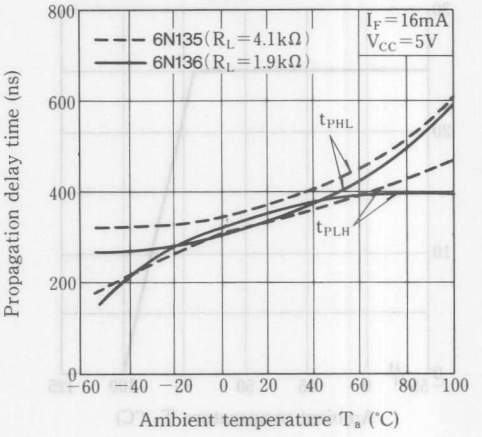


Fig. 8 Logic (1) Output Current vs. Ambient Temperature

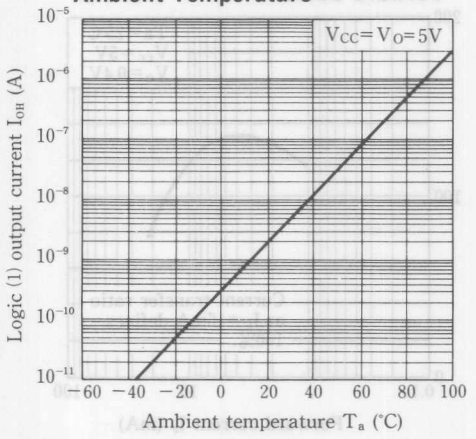
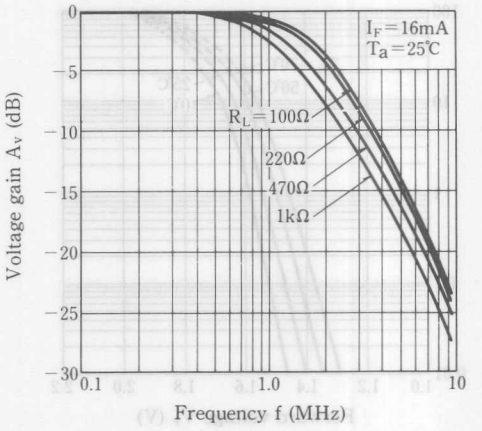
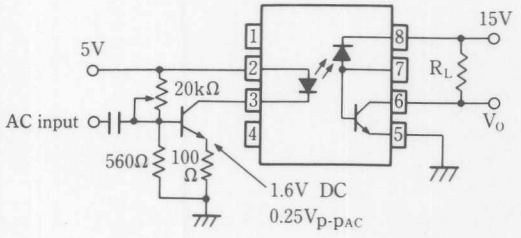


Fig. 9 Frequency Response



Test Circuit for Frequency Response



■ Precaution for Use

The minute design makes the transistor on the bipolar structumed detector vulnerable to static electricity.

To prevent damages and degradation in characteristics due to static electricity, take general measures against static electricity.

6N137 Super-High Speed Response OPIC Photocoupler

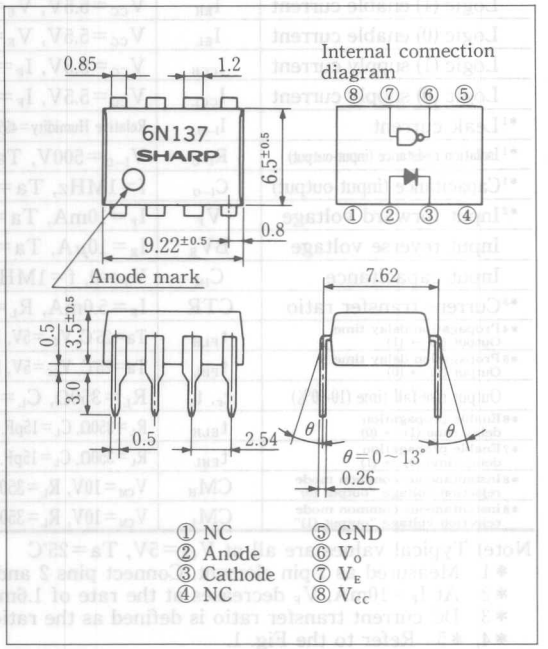
■ Features

1. Super-high speed response
   (t_{PHL}, t_{PLH}: TYP. 45ns at $R_L = 350\Omega$)
2. Isolation voltage between input and output
   V_{iso}: 2,500Vrms
3. Low input current drive (I_{FHL}: MAX. 5mA)
4. Instantaneous common mode rejection voltage
   CM_H: TYP. 500V/μs
5. LSTTL and TTL compatible output
6. Overseas standard model
7. UL recognized, file No. E64380

■ Applications

1. High speed interfaces for computer peripherals, microcomputer systems
2. High speed line receivers
3. Noise reduction
4. Interfaces for data transmission equipment

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	*1 Forward current	I_F	20	mA
	*2 Peak forward current	I_F	40	mA
	Reverse voltage	V_R	5	V
Output	*3 Supply voltage	V_{CC}	7	V
	*4 Enable voltage	V_E	5.5	V
	High level output voltage	V_{OH}	7	V
	Low level output current	I_{OL}	50	mA
	Output collector power dissipation	P_C	85	mW
*5 Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	0~+70	°C
Storage temperature		T_{stg}	−55~+125	°C
*6 Soldering temperature		T_{sol}	260	°C

*1 Ta=0~70°C
*2 Pulse width ≦ 1ms
*3 For 1 minute MAX.
*4 Not exceed 500mV or more than supply voltage (V_{CC}).
*5 AC for 1 minute, 40~60% RH
Apply the specific voltage between all the input electrode pins connected together and all the output electrode pins connected together.
*6 2mm or more away from the lead base for 10 seconds

6

■ Electro-optical Characteristics

(Ta=0~+70°C unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Logic (1) output current	I_{OH}	V_{CC}=5.5V, V_O=5.5V, I_F=250μA, V_E=2.0V	—	2	250	μA
Logic (0) output voltage	V_{OL}	V_{CC}=5.5V, I_F=5mA, V_{EH}=2.0V, I_{OL} (Sinking)=13mA	—	0.4	0.6	V
Logic (1) enable current	I_{EH}	V_{CC}=5.5V, V_E=2.0V	—	−0.8	—	mA
Logic (0) enable current	I_{EL}	V_{CC}=5.5V, V_E=0.5V	—	−1.2	−2.0	mA
Logic (1) supply current	I_{CCH}	V_{CC}=5.5V, I_F=0mA, V_E=0.5V	—	7	15	mA
Logic (0) supply current	I_{CCL}	V_{CC}=5.5V, I_F=10mA, V_E=0.5V	—	13	18	mA
*1 Leak current	I_{I-O}	Relative Humidity=45%, Ta=25°C, t=5s, V_{I-O}=3000V_{dc}	—	—	1.0	μA
*1 Isolation resistance (input-output)	R_{I-O}	V_{I-O}=500V, Ta=25°C	—	10^{12}	—	Ω
*1 Capacitance (input-output)	C_{I-O}	f=1MHz, Ta=25°C	—	0.6	—	pF
*2 Input forward voltage	V_F	I_F=10mA, Ta=25°C	—	1.6	1.75	V
Input reverse voltage	BV_R	I_R=10μA, Ta=25°C	5	—	—	V
Input capacitance	C_{IN}	V_F=0, f=1MHz	—	60	—	pF
*3 Current transfer ratio	CTR	I_F=5.0mA, R_L=100Ω	—	700	—	%
*4 Propagation delay time Output (0) → (1)	t_{PLH}	Ta=25°C, V_{CC}=5V, R_L=350Ω, C_L=15pF, I_F=7.5mA	—	45	75	ns
*5 Propagation delay time Output (1) → (0)	t_{PHL}	Ta=25°C, V_{CC}=5V, R_L=350Ω, C_L=15pF, I_F=7.5mA	—	45	75	ns
Output rise-fall time (10-90%)	t_r, t_f	R_L=350Ω, C_L=15pF, I_F=7.5mA	—	20, 30	—	ns
*6 Enable propagation delay time (1) → (0)	t_{ELH}	R_L=350Ω, C_L=15pF, I_F=7.5mA, V_{EH}=3.0V, V_{EL}=0.5V	—	40	—	ns
*7 Enable propagation delay time (0) → (1)	t_{EHL}	R_L=350Ω, C_L=15pF, I_F=7.5mA, V_{EH}=3.0V, V_{EL}=0.5V	—	15	—	ns
*8 Instantaneous common mode rejection voltage "output (0)"	CM_H	V_{CM}=10V, R_L=350Ω, V_O (min.)=2V, I_F=0mA	—	500	—	V/μs
*8 Instantaneous common mode rejection voltage "output (1)"	CM_L	V_{CM}=10V, R_L=350Ω, V_O (max.)=0.8V, I_F=5mA	—	−500	—	V/μs

Note) Typical values are all at V_{CC}=5V, Ta=25°C

*1 Measured as 2-pin element. Connect pins 2 and 3, connect pins 5, 6, 7 and 8.

*2 At I_F=10mA, V_F decreases at the rate of 1.6mV/°C if the temperature goes up.

*3 DC current transfer ratio is defined as the ratio of output collector current to forward bias input current.

*4, *5 Refer to the Fig. 1.

*6, *7 Refer to the Fig. 2.

*8 CM_H represents a common mode voltage ignorable rise time ratio that can hold logic (1) state in output. CM_L represents a common mode voltage ignorable fall time ratio that can hold logic (0) state in output.

■ Recommended Operating Conditions

Parameter	Symbol	MIN.	MAX.	Unit
Low level input current	I_{FL}	0	250	μA
High level input current	I_{FH}	*6.3	15	mA
High level enable voltage	V_{EH}	2.0	V_{CC}	V
Low level enable voltage	V_{EL}	0	0.8	V
Supply voltage	V_{CC}	4.5	5.5	V
Fanout (TTL load)	N	—	8	
Operating temperature	T_{opr}	0	70	°C

1. No necessary external pull-up resistor to hold enable input at high level
2. Connect a ceramic by-pass capacitor (0.01~0.1μF) between V_{CC} and GND at the position within 1cm from pin.
3. * 20% giard band, switching threshold for degradation of CTR are 5mA or less at initial value.

Truth Table

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H

L : Logic (0) H : Logic (1)

Circuit Block Diagram

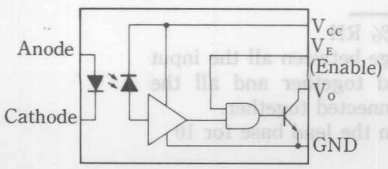


Fig. 1 Test Circuit for Propagation Delay time

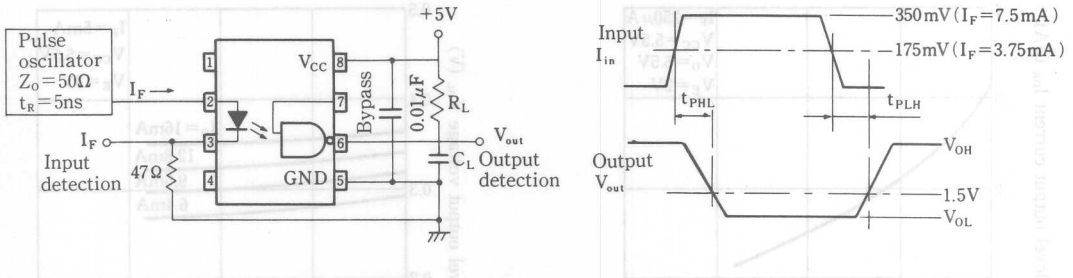


Fig. 2 Test Circuit for Enable Propagation Delay Time

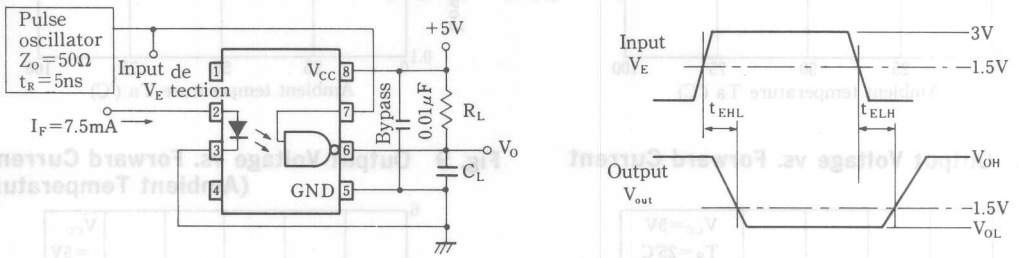


Fig. 3 Test Circuit for Instantaneous Common Mode Rejection Voltage

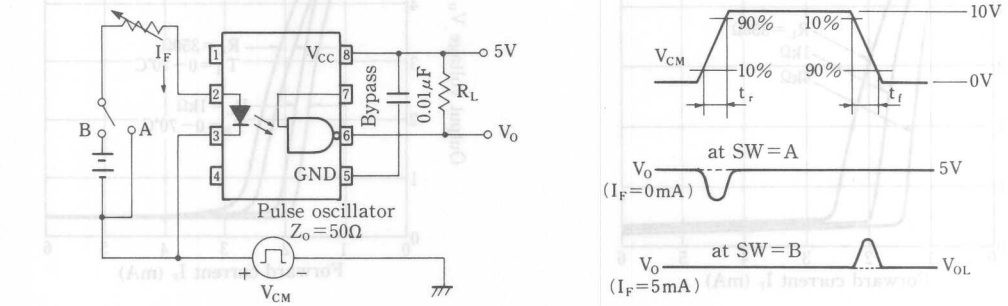


Fig. 4 Output Collector Power Dissipation vs. Ambient Temperature

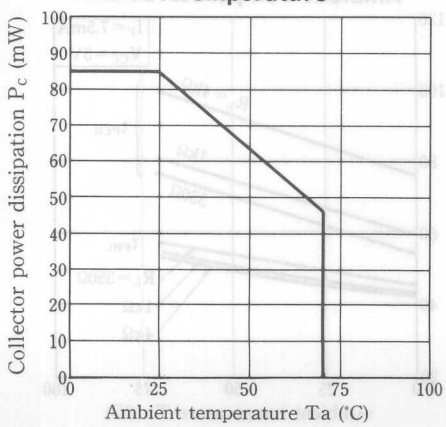
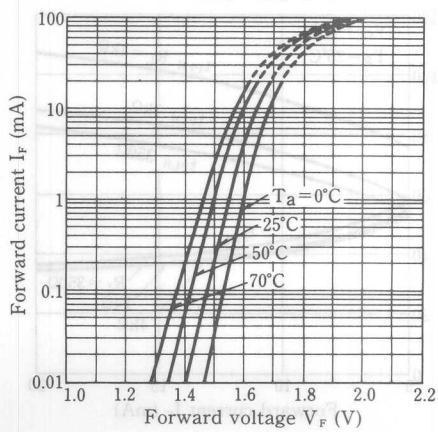


Fig. 5 Forward Current vs. Forward Voltage



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Fig. 6 High Level Output Current vs. Ambient Temperature

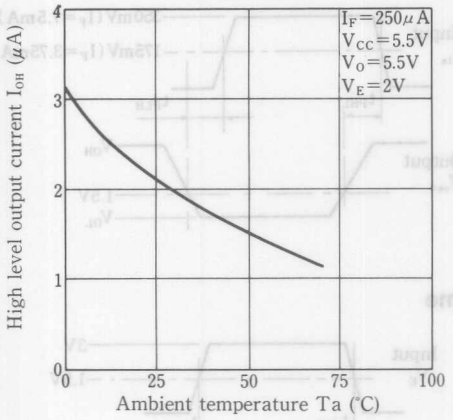


Fig. 7 Low Level Output Current vs. Ambient Temperature

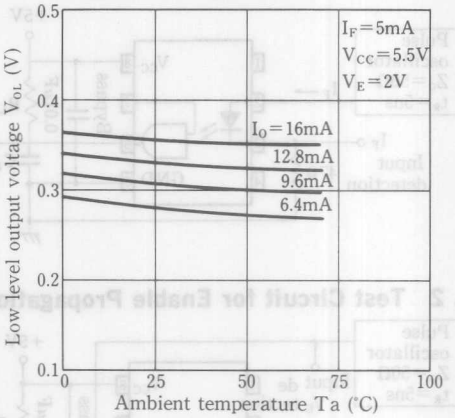


Fig. 8 Output Voltage vs. Forward Current

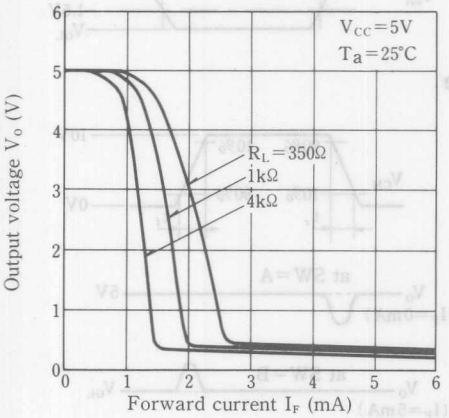


Fig. 9 Output Voltage vs. Forward Current (Ambient Temperature)

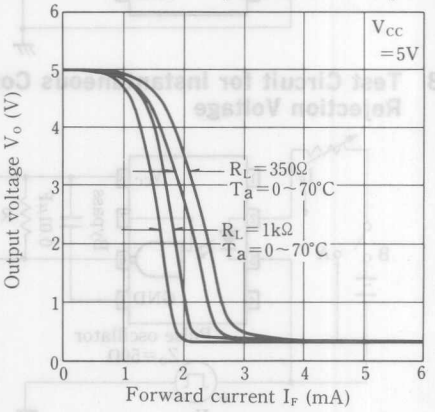


Fig. 10 Propagation Delay Time vs. Forward Current

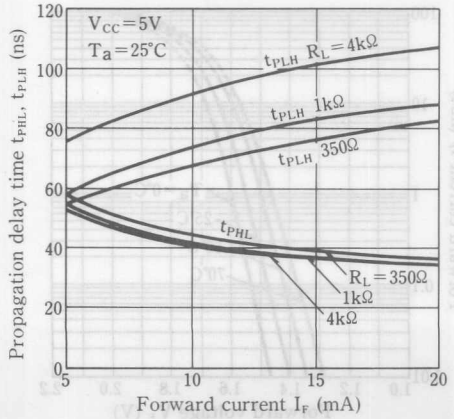


Fig. 11 Propagation Delay Time vs. Ambient Temperature

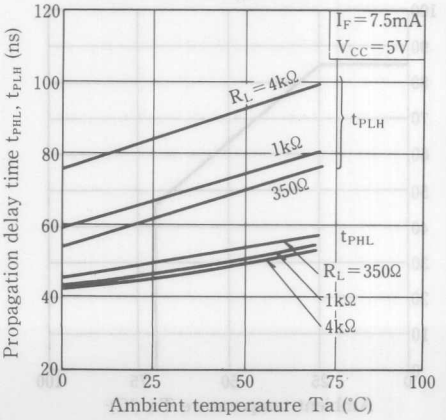


Fig. 12 Rise Time, Fall Time vs. Ambient Temperature

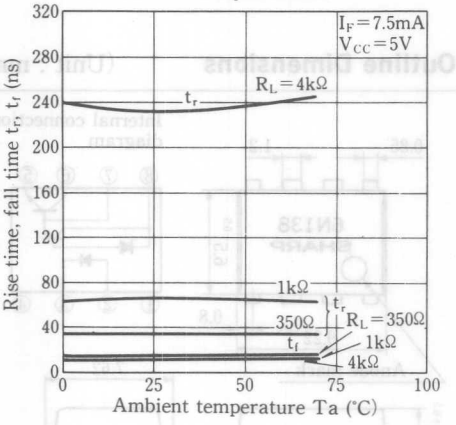
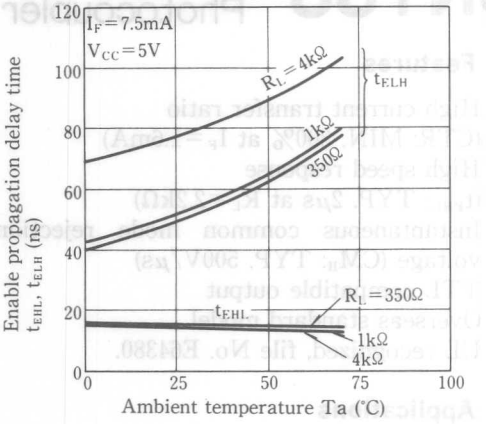


Fig. 13 Enable Propagation Delay Time vs. Ambient Temperature



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6N138 High Sensitivity, High Speed OPIC Photocoupler

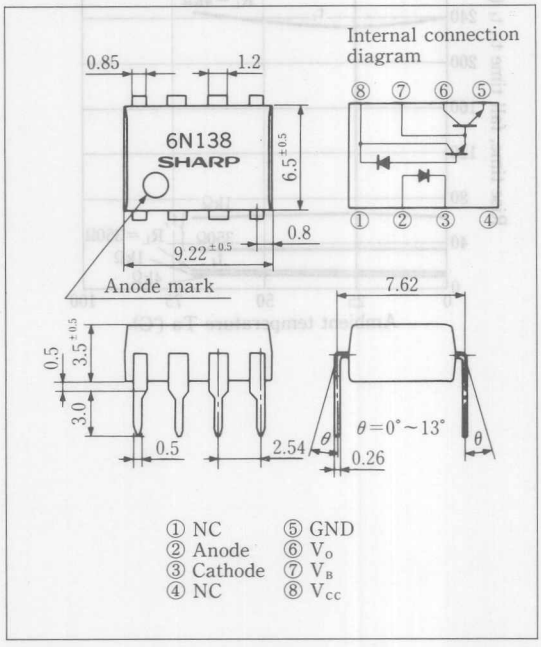
■ Features

1. High current transfer ratio (CTR: MIN. 300% at I_F=1.6mA)
2. High speed response (t_{PHL}: TYP. 2μs at R_L=2.2kΩ)
3. Instantaneous common mode rejection voltage (CM_H: TYP. 500V/μs)
4. TTL compatible output
5. Overseas standard model
6. UL recognized, file No. E64380.

■ Applications

1. Interfaces for computer peripherals
2. Electronic calculators, measuring instruments, control equipment
3. Telephone sets
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	20	mA
	*1Peak forward current	I_F	40	mA
	*2Peak transient forward current	I_{FM}	1	A
	Reverse voltage	V_R	5	V
	Power dissipation	P	35	mW
Output	Supply voltage	V_{CC}	−0.5~+7	V
	Output voltage	V_O	−0.5~+7	V
	Emitter-base reverse withstand voltage (Pin 5-7)	V_{EBO}	0.5	V
	*3Average output current	I_O	60	mA
	Power dissipation	P_O	100	mW
*4Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	0~+70	°C
Storage temperature		T_{stg}	−55~+125	°C
*5Soldering temperature		T_{sol}	260	°C

*1 50% duty cycle, Pulse width=1ms
*2 Pulse width≦1μs, 300pps
*3 Decreases at the rate of 0.7mA/°C if the external temperature is 25°C or more.
*4 RH=40~60%, AC for 1 minute
*5 For 10 seconds

■ Electro-optical Characteristics (Ta=0~70°C unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*1Current transfer ratio	CTR	I_F=1.6mA, V_O=0.4V, V_{CC}=4.5V	300	1,600	—	%
Logic (0) output voltage	V_{OL}	I_O=4.8mA, V_{CC}=4.5V, I_F=1.6mA	—	0.1	0.4	V
Logic (1) output current	I_{OH}	I_F=0, V_{CC}=V_O=7V	—	0.1	250	μA
Logic (0) supply current	I_{CCL}	I_F=1.6mA, V_{CC}=5V, V_O=open	—	0.5	—	mA
Logic (1) supply current	I_{CCH}	I_F=0, V_{CC}=5V, V_O=open	—	10	—	nA
Input forward voltage	V_F	I_F=1.6mA, Ta=25°C	—	1.5	1.7	V
Input forward voltage temperature coefficient	*2	I_F=1.6mA	—	−1.9	—	mV/°C
Input reverse voltage	BV_R	I_R=10μA, Ta=25°C	5.0	—	—	V
Input capacitance	C_{IN}	V_F=0, f=1MHz	—	60	—	pF
*3Leak current (input-output)	I_{I-O}	Ta=25°C, RH=45%, t=5s V_{I-O}=3kV DC	—	—	1.0	μA
*3Isolation resistance (input-output)	R_{I-O}	V_{I-O}=500V DC	—	10^{12}	—	Ω
*3Capacitance (input-output)	C_{I-O}	f=1MHz	—	0.6	—	pF

*1 Current transfer ratio is a ratio of input current and output current expressed in %.

Note) Typical value : at Ta=25°C, V_{CC}=5V.

*2 $\Delta V_F/\Delta Ta$

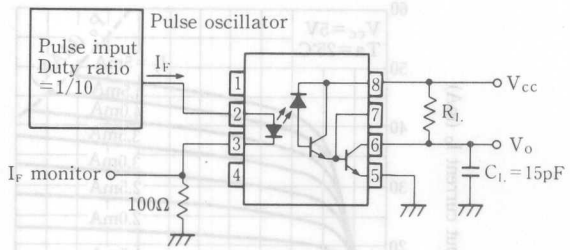
*3 Measured as 2-pin element (Short 1, 2, 3, 4 and 5, 6, 7, 8.)

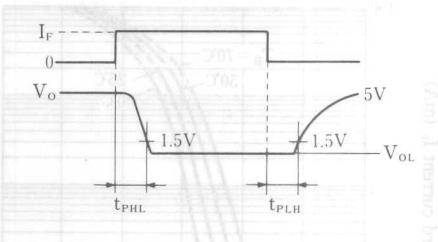
■ Switching Characteristics (Ta=25°C, V_{CC}=5V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*4Propagation delay time Output (1) → (0)	t_{PHL}	I_F=1.6mA R_L=2.2kΩ	—	2	10	μs
*4Propagation delay time Output (0) → (1)	t_{PLH}	I_F=1.6mA R_L=2.2kΩ	—	7	35	μs
*5Instantaneous common mode *6rejection voltage "Output (1)"	CM_H	I_F=0, V_{CM}=10V_{P-P} R_L=2.2kΩ	—	500	—	V/μs
*5Instantaneous common mode *6rejection voltage "Output (0)"	CM_L	I_F=1.6mA, V_{CM}=10V_{P-P} R_L=2.2kΩ	—	−500	—	V/μs

*5 Instantaneous common mode rejection voltage "output (1)" represents a common mode voltage variation that can hold the output above (1) level (V_O>2.0V).
Instantaneous common mode rejection voltage "output (0)" represents a common mode voltage variation that can hold the output above (0) level (V_O<0.8V).

*4 Test circuit for Propagation Delay Time





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*5 Test Circuit for Instantaneous Common Mode Rejection Voltage

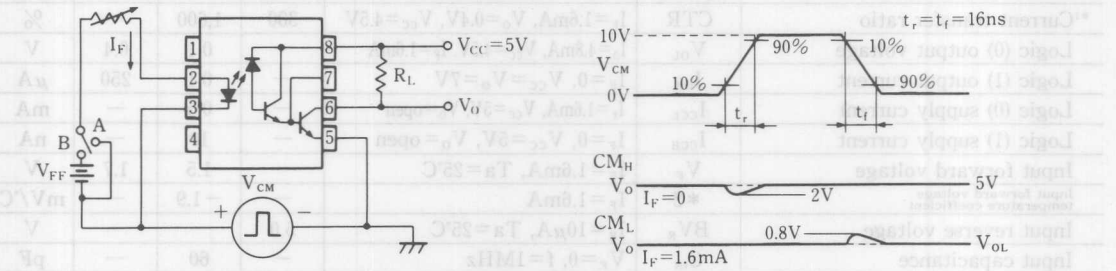


Fig. 1 Forward Current vs. Ambient Temperature

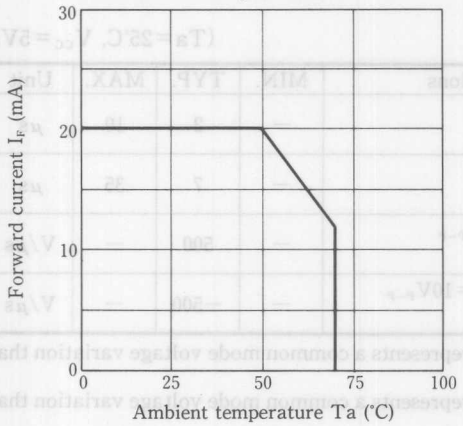


Fig. 2 Power Dissipation vs. Ambient Temperature

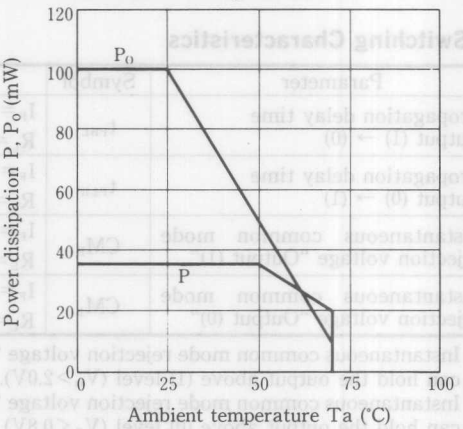


Fig. 3 Forward Current vs. Forward Voltage

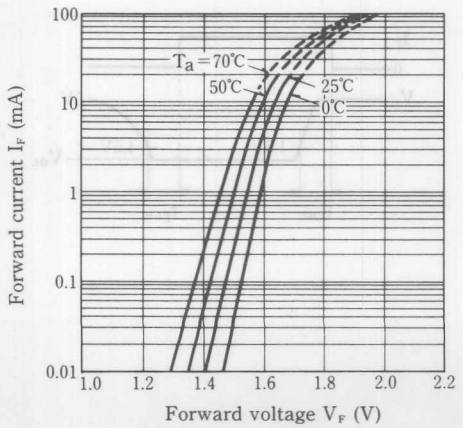


Fig. 4 Output Current vs. Output Voltage

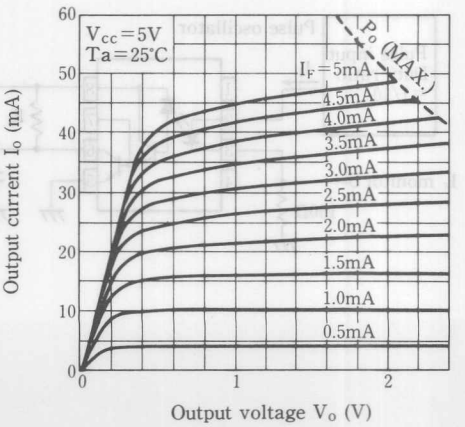


Fig. 5 Current Transfer Ratio vs. Forward Current

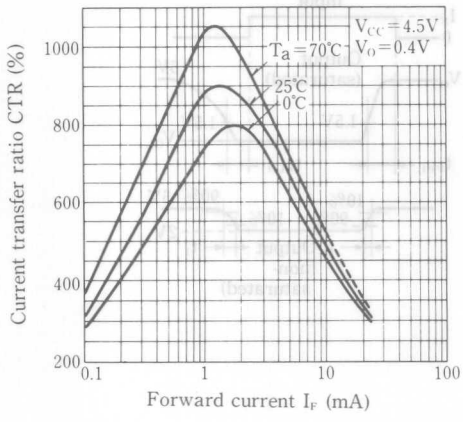


Fig. 6 Output Current vs. Forward Current

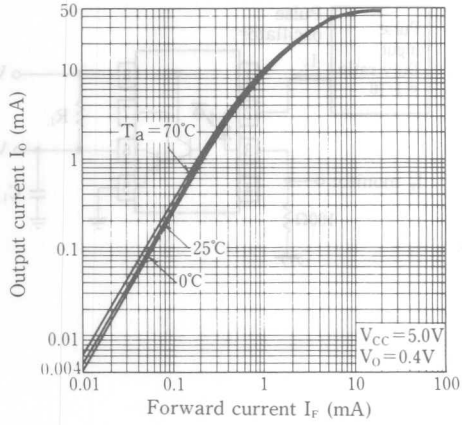


Fig. 7 Propagation Delay Time vs. Ambient Temperature (1)

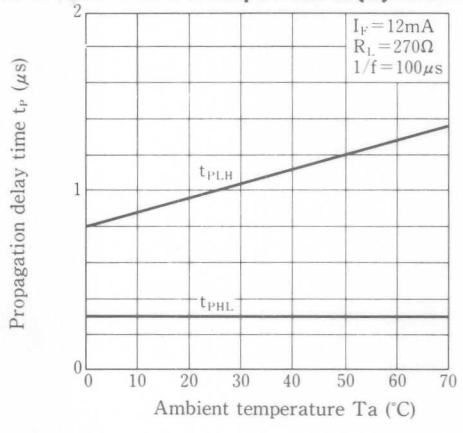


Fig. 8 Propagation Delay Time vs. Ambient Temperature (2)

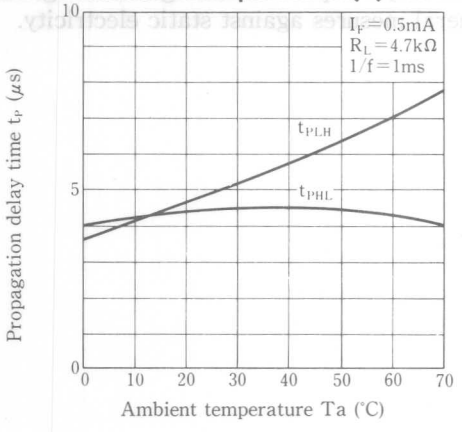


Fig. 9 Rise Time, Fall Time vs. Load Resistance

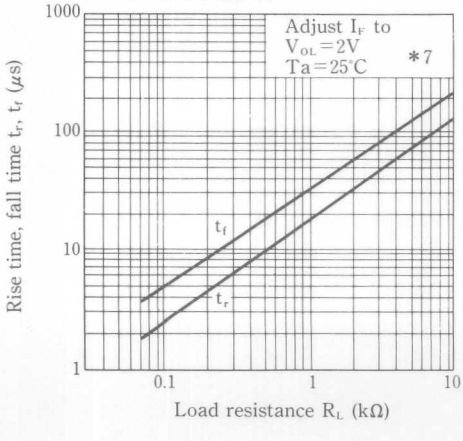
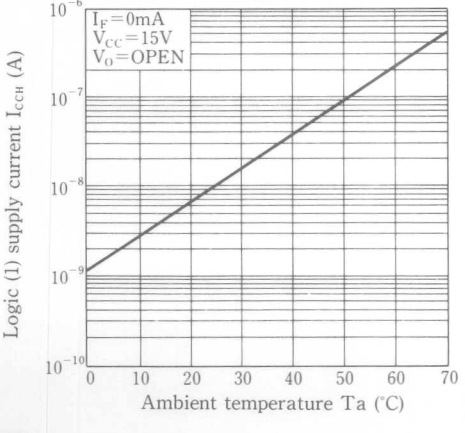
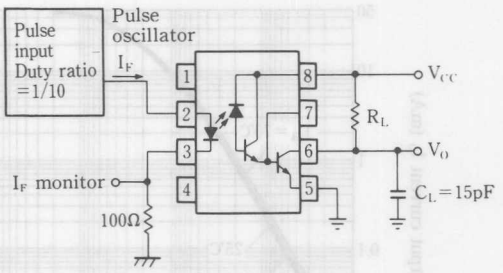


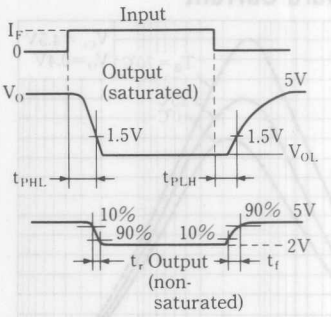
Fig. 10 Logic (1) Supply Current vs. Ambient Temperature



6

*7 Test Circuit for Rise Time, Fall Time vs. Load Resistance





■ Precautions for Use

The minute design makes the transistor on the bipolar structured detector vulnerable to static electricity. To prevent damages and degradation in characteristics due to static electricity, take general mesures against static electricity.

6N139 High Sensitivity, High Speed OPIC Photocoupler

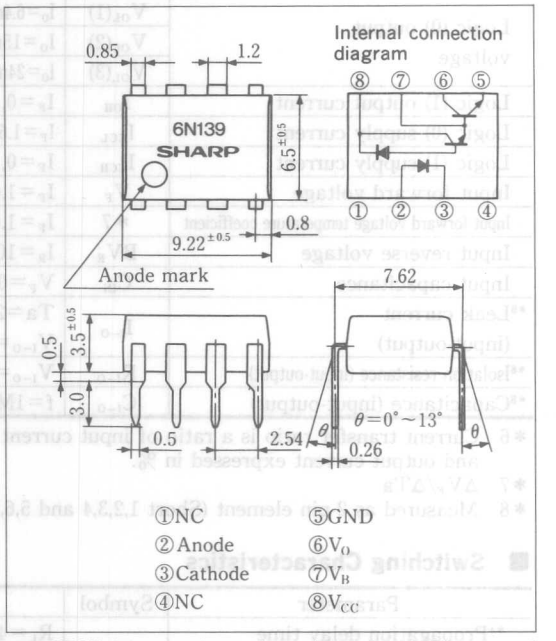
■ Features

1. High current transfer ratio
   (CTR: MIN. 500% at I_F=1.6mA)
2. High speed response
   (t_{PHL}: TYP. 0.2μs at R_L=270Ω)
3. High common mode rejection voltage
   (CM_H: TYP. 500V/μs)
4. TTL compatible output
5. UL recognized, file No. E64380

■ Applications

1. Interfaces for computer peripherals
2. Computers, measuring instruments, control equipment
3. Telephone sets
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	20	mA
	*1Peak forward current	I_F	40	mA
	*2Peak transient forward current	I_{FM}	1	A
	Reverse voltage	V_R	5	V
	Power dissipation	P	35	mW
Output	Supply voltage	V_{CC}	−0.5~+18	V
	Output voltage	V_O	−0.5~+18	V
	Emitter-base reverse withstand voltage (Pin 5~7)	V_{EBO}	0.5	V
	*3Average output current	I_O	60	mA
	Power dissipation	P_O	100	mW
*4Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	0~+70	°C
Storage temperature		T_{stg}	−55~+125	°C
*5Soldering temperature		T_{sol}	260	°C

*1 50% duty cycle, Pulse width=1ms
*2 Pulse width≦1μs, 300pps
*3 Decreases at the rate of 0.7mA/°C if the external temperature is more than 25°C
*4 RH=40~60%, AC for 1 minute
*5 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=0~70°C unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*6Current transfer ratio	CTR(1)	I_F=0.5mA, V_O=0.4V, V_{CC}=4.5V	400	1,800	—	%
	CTR(2)	I_F=1.6mA, V_O=0.4V, V_{CC}=4.5V	500	1,600	—	%
Logic (0) output voltage	V_{OL}(1)	I_O=6.4mA, V_{CC}=4.5V, I_F=1.6mA	—	0.1	0.4	V
	V_{OL}(2)	I_O=15mA, V_{CC}=4.5V, I_F=5mA	—	0.1	0.4	V
	V_{OL}(3)	I_O=24mA, V_{CC}=4.5V, I_F=12mA	—	0.2	0.4	V
Logic (1) output current	I_{OH}	I_F=0, V_{CC}=V_O=18V	—	0.05	100	μA
Logic (0) supply current	I_{CCL}	I_F=1.6mA, V_{CC}=5V, V_O=open	—	0.5	—	mA
Logic (1) supply current	I_{CCH}	I_F=0, V_{CC}=5V, V_O=open	—	10	—	nA
Input forward voltage	V_F	I_F=1.6mA, Ta=25°C	—	1.5	1.7	V
Input forward voltage temperature coefficient	*7	I_F=1.6mA	—	−1.9	—	mV/°C
Input reverse voltage	BV_R	I_R=10μA, Ta=25°C	5.0	—	—	V
Input capacitance	C_{IN}	V_F=0, f=1MHz	—	60	—	pF
*8Leak current (input-output)	I_{I-O}	Ta=25°C, RH=45%, t=5s V_{I-O}=3kV DC	—	—	1.0	μA
*8Isolation resistance (input-output)	R_{I-O}	V_{I-O}=500V DC	—	10^{12}	—	Ω
*8Capacitance (input-output)	C_{I-O}	f=1MHz	—	0.6	—	pF

*6 Current transfer ratio is a ratio of input current and output current expressed in %.

Note) Typical value: at Ta=25°C, V_{CC}=5V

*7 $\Delta V_F/\Delta Ta$

*8 Measured as 2-pin element (Short 1,2,3,4 and 5,6,7,8.)

■ Switching Characteristics

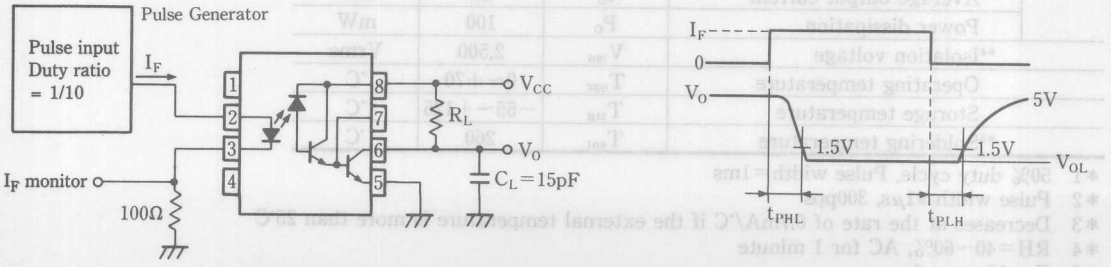
(Ta=25°C, V_{CC}=5V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
*4Propagation delay time Output(1)→(0)	t_{PHL}	R_L=4.7kΩ, I_F=0.5mA	—	5	25	μs
		R_L=270Ω, I_F=12mA	—	0.3	1	μs
*4Propagation delay time Output(0)→(1)	t_{PLH}	R_L=4.7kΩ, I_F=0.5mA	—	10	60	μs
		R_L=270Ω, I_F=12mA	—	1.5	7	μs
*5*6Instantaneous common mode rejection voltage "Output(1)"	CM_H	I_F=0, V_{CM}=10V_{p-p} R_L=2.2kΩ	—	500	—	V/μs
*5*6Instantaneous common mode rejection voltage "Output(0)"	CM_L	I_F=1.6mA, V_{CM}=10V_{p-p} R_L=2.2kΩ	—	−500	—	V/μs

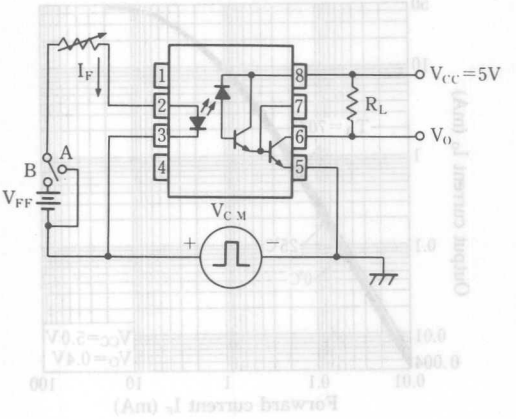
*5 Instantaneous common mode rejection voltage "output (1)" represents a common mode voltage variation that can hold the output above (1) level (V_O>2.0V).

*6 Instantaneous common mode rejection voltage "output (0)" represents a common mode voltage variation that can hold the output above (0) level (V_O<0.8V).

※4 Test Circuit for Propagation Delay Time



※6 Test Circuit for Instantaneous Common Mode Rejection Voltage



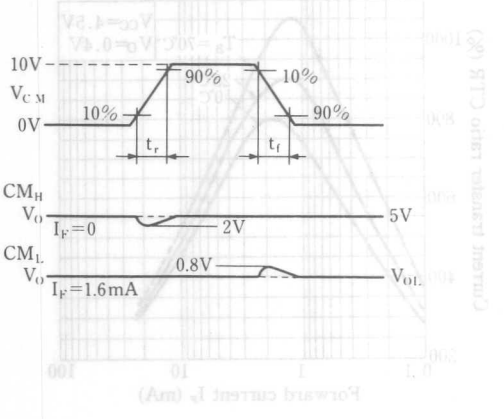


Fig. 1 Forward Current vs. Ambient Temperature

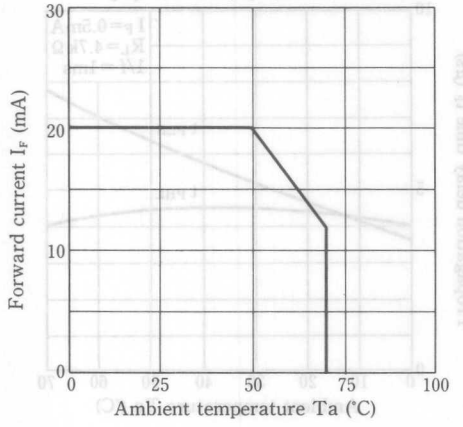


Fig. 2 Power Dissipation vs. Ambient Temperature

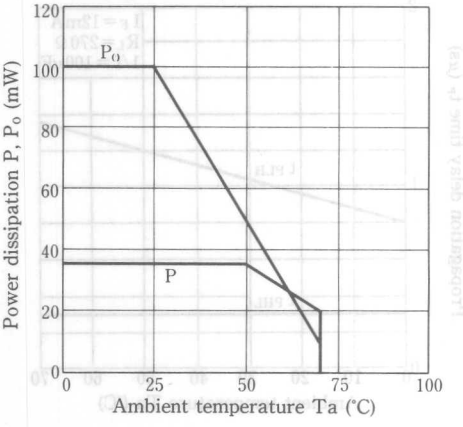


Fig. 3 Forward Current vs. Forward Voltage

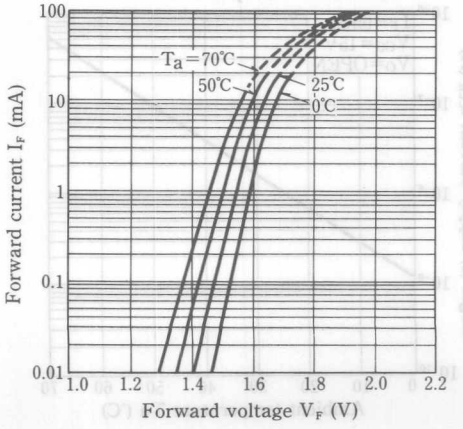
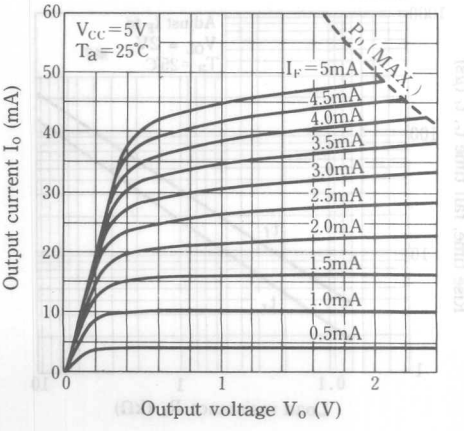


Fig. 4 Output Current vs. Output Voltage



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Fig. 5 Current Transfer Ratio vs. Forward Current

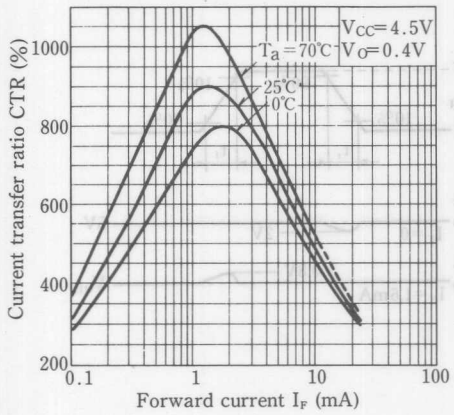


Fig. 6 Output Current vs. Forward Current

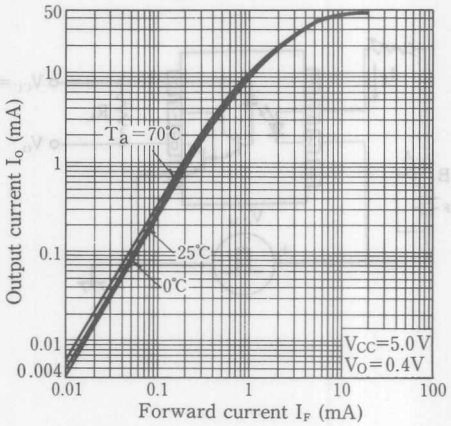


Fig. 7 Propagation Delay Time vs. Ambient Temperature (1)

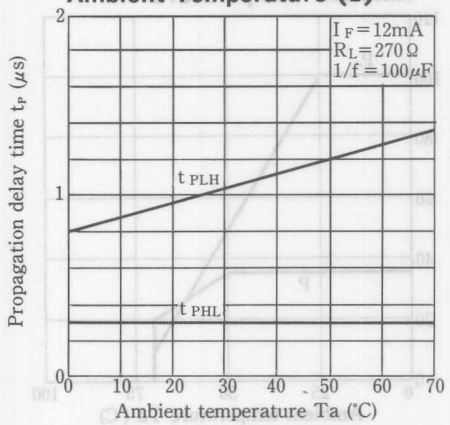


Fig. 8 Propagation Delay Time vs. Ambient Temperature (2)

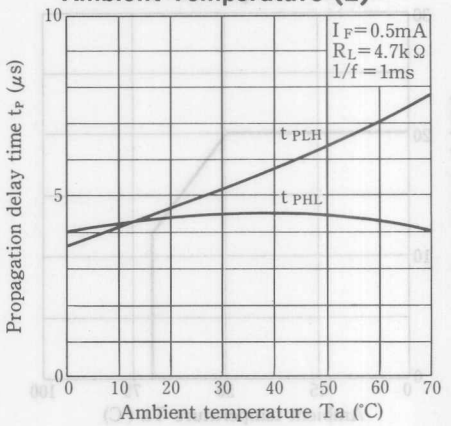


Fig. 9 Rise Time, Fall Time vs. Load Resistance

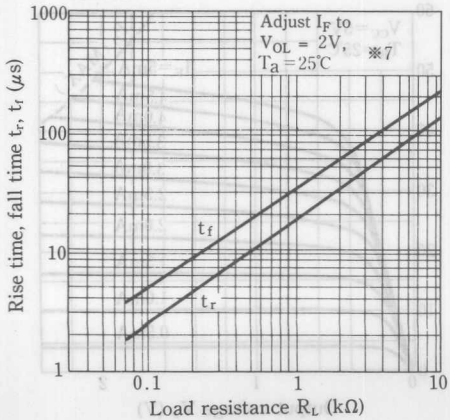
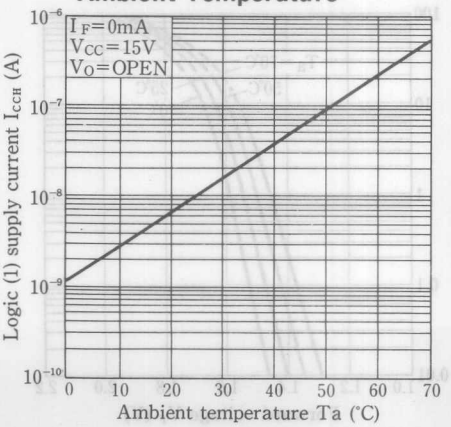
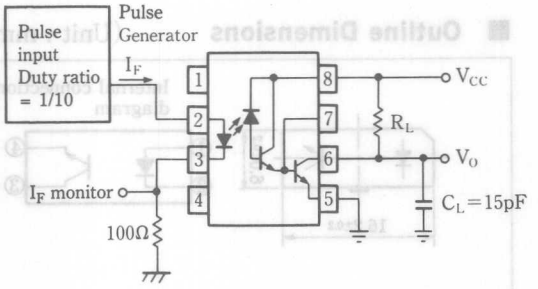
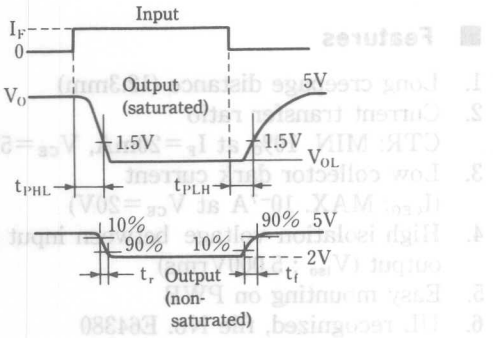


Fig. 10 Logic (1) Supply Current vs. Ambient Temperature



※7 Test Circuit for Rise Time, Fall Time vs. Load resistance





■ Precautions for Use

The minute design makes the transistor on the bipolar structured detector vulnerable to static electricity.

To prevent damages and degradation in characteristics due to static electricity, take general measures against static electricity.

6

PC511 Long Creepage Distance Type Photocoupler

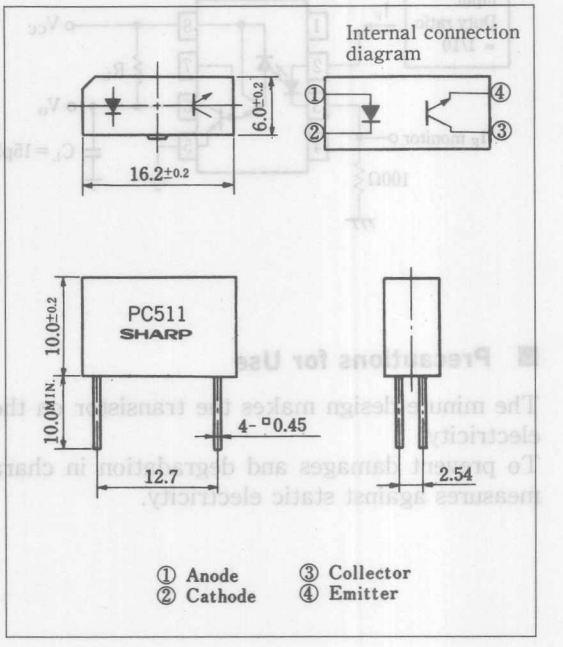
■ Features

1. Long creepage distance (12.3mm)
2. Current transfer ratio
   CTR: MIN. 10% at I_F=20mA, V_{CE}=5V
3. Low collector dark current
   (I_{CEO}: MAX. 10^{-7}A at V_{CE}=20V)
4. High isolation voltage between input and output (V_{iso} : 5,000Vrms)
5. Easy mounting on PWB
6. UL recognized, file No. E64380
   TÜV approved, No. R20044

■ Applications

1. Switching power supplies
2. Programmable controllers
3. Electronic sewing machines, copiers, automatic vending machines
4. Electric home appliances, audio equipment

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25～+95	°C
Storage temperature		T_{stg}	−40～+105	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	50	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	10	—	100	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=1mA	—	0.1	0.4	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.5	—	pF
	Cut-off frequency	f_c	V_{CE}=2V, I_C=2mA, R_L=100Ω	12	80	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	3	20	μs
	Response time (Fall)	t_f	R_L=100Ω	—	4	30	μs

Fig. 1 Forward Current vs. Ambient Temperature

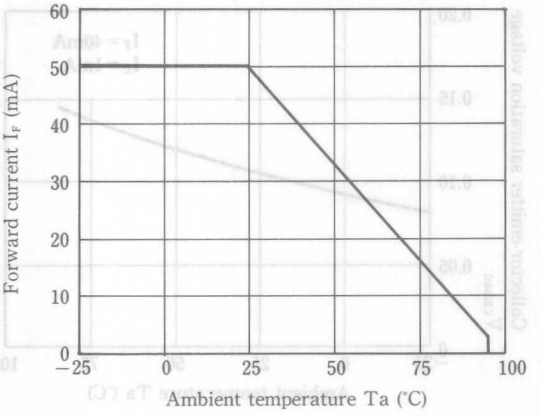


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

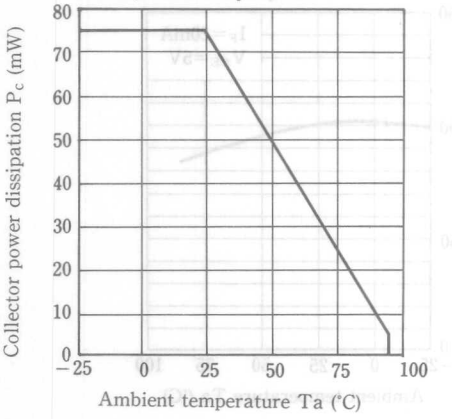


Fig. 3 Peak Forward Current vs. Duty Ratio

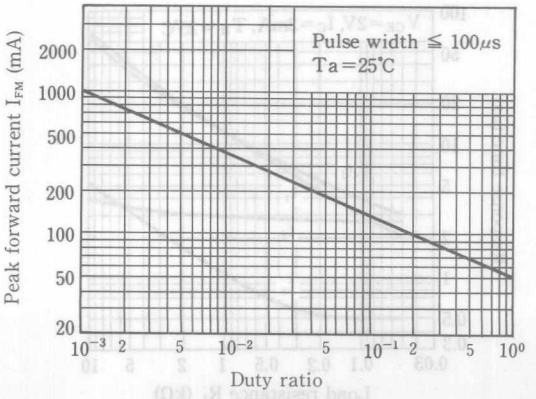
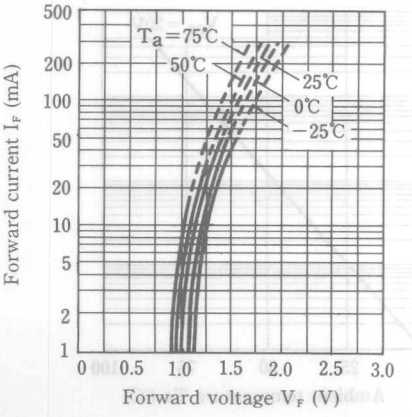


Fig. 4 Forward Current vs. Forward Voltage



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Fig. 5 Current Transfer Ratio vs. Forward Current

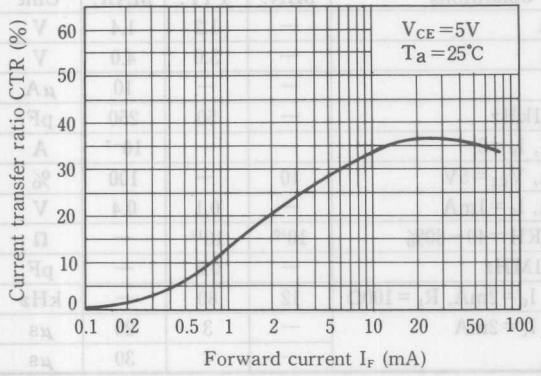


Fig. 6 Collector Current vs. Collector-emitter Voltage

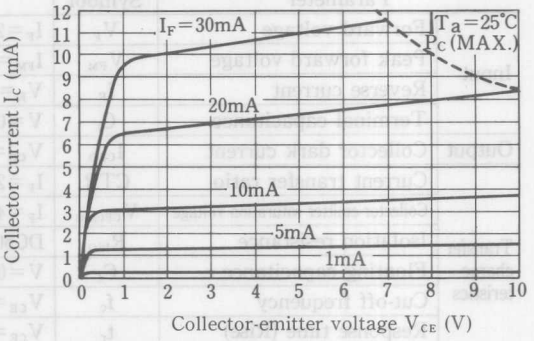


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

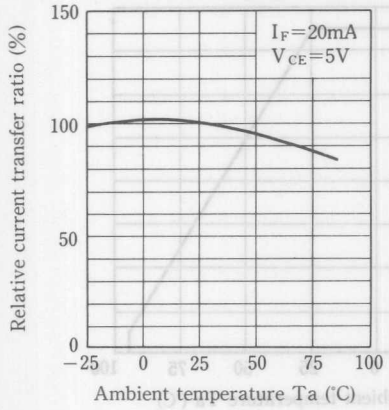


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

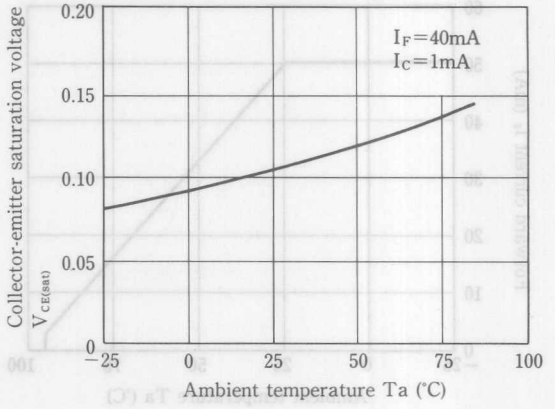


Fig. 9 Collector Dark Current vs. Ambient Temperature

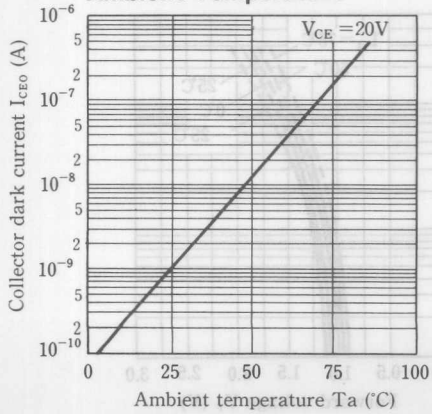
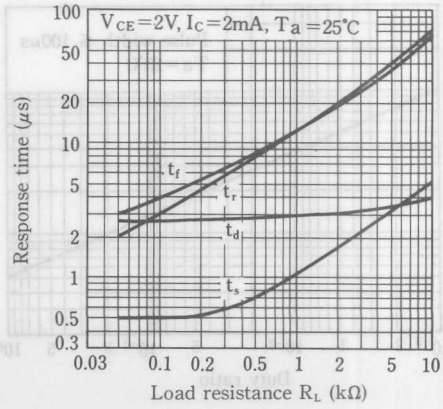


Fig. 10 Response Time vs. Load Resistance



Test Circuit for Response Time

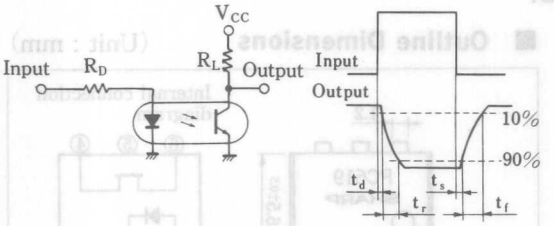


Fig. 11 Frequency Response

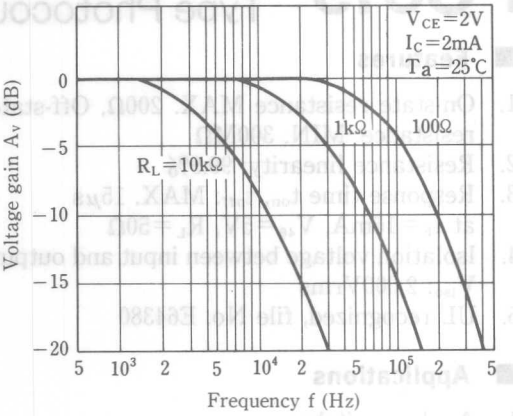
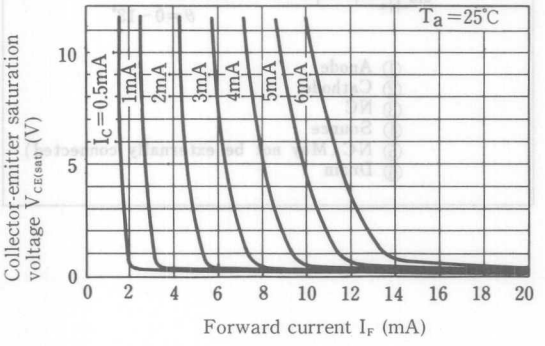
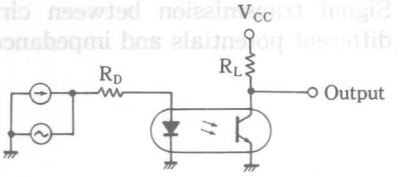


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



6

PC619 Bi-directional Linear Output Type Photocoupler

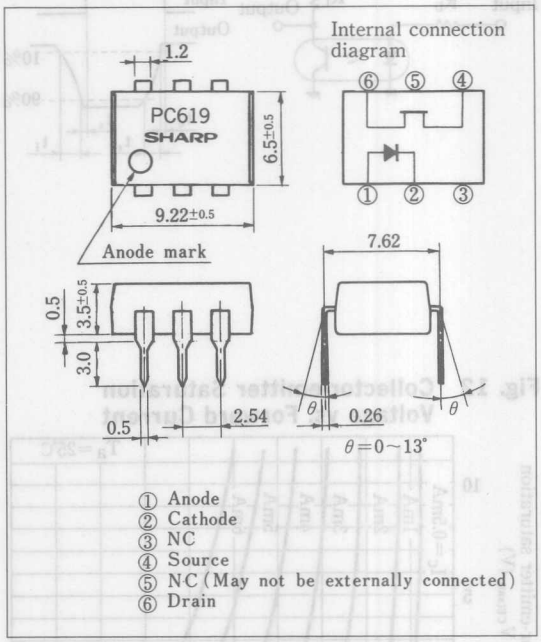
■ Features

1. On-state resistance MAX. 200Ω, Off-state resistance: MIN. 300MΩ
2. Resistance linearity: 99.9%
3. Response time t_{on}, t_{off}: MAX. 15μs at I_F=16mA, V_{46}=5V, R_L=50Ω
4. Isolation voltage between input and output V_{iso}: 2,000Vrms
5. UL recognized, file No. E64380

■ Applications

1. Analog switches
2. Audio equipment, such as VCRs, radio-cassette tape recorders, and stereo components, etc.
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	60	mA
	*1Peak forward current	I_{FM}	0.5	A
	Reverse voltage	V_R	6	V
	Power dissipation	P_1	150	mW
Output	Output current	I_O	100	mA
	*2Breakdown voltage	V_{BR}	30	V
	Power dissipation	P_2	300	mW
*3Isolation voltage		V_{iso}	2,000	Vrms
Operating temperature		T_{opr}	−25~+100	°C
Storage temperature		T_{stg}	−40~+125	°C
*4Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 Applies to forward and reverse directions between terminals 4 and 6
*3 RH=40~60%, AC for 1 minute
*4 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=16mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=6V	—	—	10	μA
	Terminal capacitance	C_{t1}	V=0, f=1MHz	—	50	250	pF
Output	*2Collector dark current	I_d	V_{46}=15V, I_F=0	—	—	50	nA
	*2Off-state resistance	R_{OFF}	V_{46}=15V, I_F=0	300	—	—	MΩ
	*2On-state resistance	R_{ON}	I_F=16mA, I_{46}=100μA	—	—	200	Ω
	Terminal capacitance	C_{t2}	V_{46}=0, f=1MHz	—	—	15	pF
Transfer characteristics	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	10^{11}	—	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	—	2.5	pF
	Turn-on time	t_{on}	I_F=16mA, V_{46}=5V, R_L=50Ω	—	—	15	μs
	Turn-off time	t_{off}		—	—	15	μs
	Resistance linearity	—	I_F=16mA, I_{46}=25μArms, f=1kHz	—	99.9	—	%

*2 Applies to forward and reverse directions between terminals 4 and 6

6

Fig. 1 Forward Current vs. Ambient Temperature

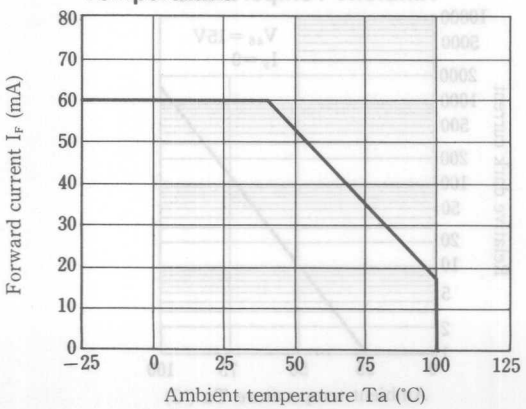


Fig. 2 Output Power Dissipation vs. Ambient Temperature

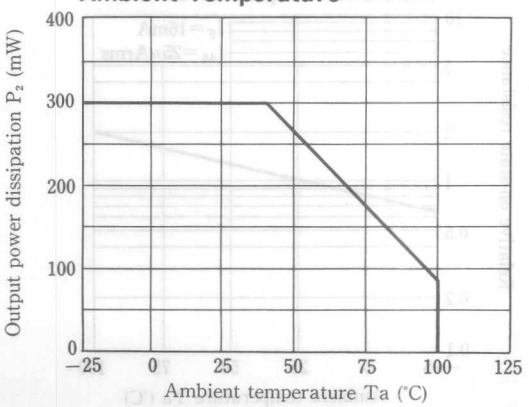


Fig. 3 Peak Forward Current vs. Duty Ratio

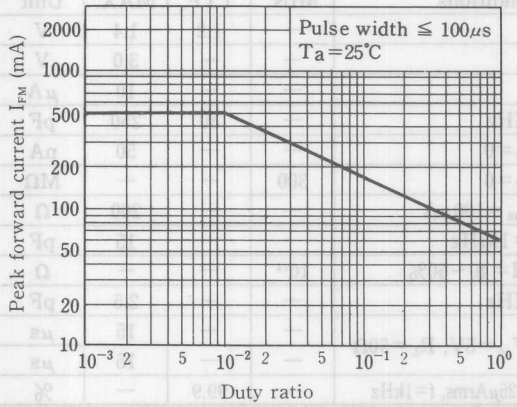


Fig. 4 Forward Current vs. Forward Voltage

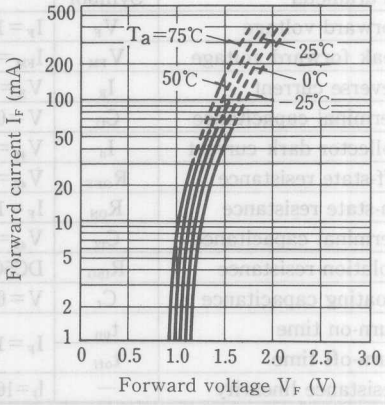


Fig. 5 Output Current vs. Output Voltage

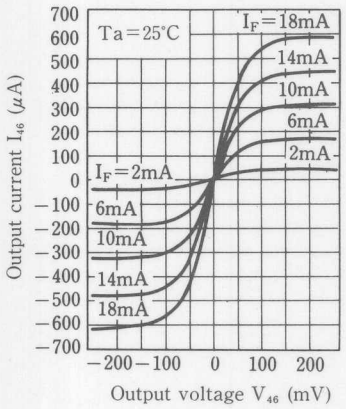


Fig. 6 Relative On-state Resistance vs. Forward Current

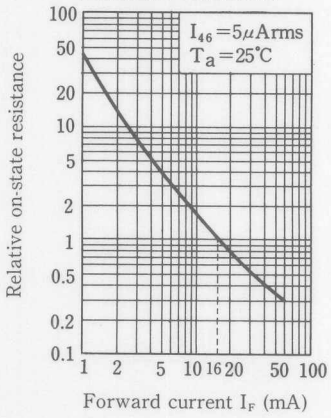


Fig. 7 Relative On-state Resistance vs. Ambient Temperature

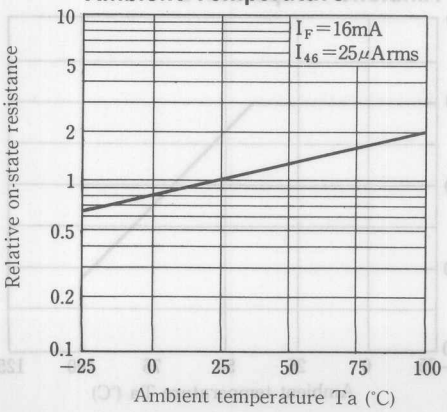
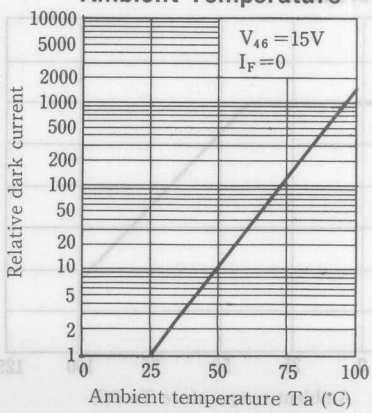


Fig. 8 Relative Dark Current vs. Ambient Temperature



PC702V High Collector-emitter Voltage Type Photocoupler

※ Lead forming type (I type) is also available. (PC702VI) (Page 482)

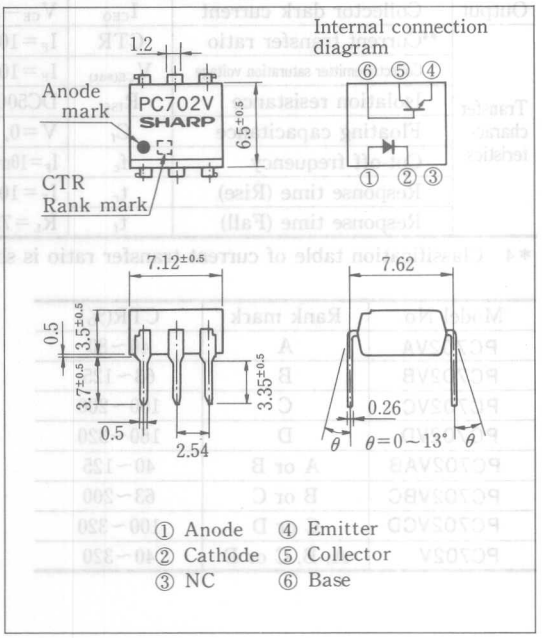
■ Features

1. High collector-emitter voltage (V_{CEO}: 70V)
2. High isolation voltage between input and output (V_{ISO}: 5,000Vrms)
3. TTL compatible output
4. UL recognized, file No. E64380
   TÜV approved, No. R40181

■ Applications

1. Telephone sets, telephone exchangers
2. System appliances, measuring instruments
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	60	mA
	*1Peak forward current	I_{FM}	1.5	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	105	mW
Output	Collector-emitter voltage	V_{CEO}	70	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector-base voltage	V_{CBO}	70	V
	Emitter-base voltage	V_{EBO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	160	mW
	Total power dissipation	P_{tot}	200	mW
	*2Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−55~+100	°C
	Storage temperature	T_{stg}	−55~+150	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≤10μs, Duty ratio=0.0004
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=60mA	—	1.4	1.7	V
	Reverse current	I_R	V_R=6V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=10V, I_F=0	—	—	5×10^{-8}	A
Transfer characteristics	*4Current transfer ratio	CTR	I_F=10mA, V_{CE}=5V	40	—	320	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=10mA, I_C=2.5mA	—	0.1	0.4	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	I_F=10mA, V_{CC}=5V, R_L=75Ω, R_{BE}=∞	—	150	—	kHz
	Response time (Rise)	t_r	I_F=10mA, V_{CC}=5V	—	2	7	μs
	Response time (Fall)	t_f	R_L=75Ω, R_{BE}=∞	—	2	8	μs

*4 Classification table of current transfer ratio is shown below.

Model No.	Rank mark	CTR(%)
PC702VA	A	40~80
PC702VB	B	63~125
PC702VC	C	100~200
PC702VD	D	160~320
PC702VAB	A or B	40~125
PC702VBC	B or C	63~200
PC702VCD	C or D	100~320
PC702V	A, B, C or D	40~320

Fig. 1 Forward Current vs. Ambient Temperature

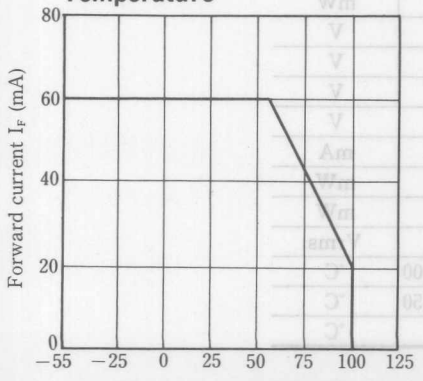


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

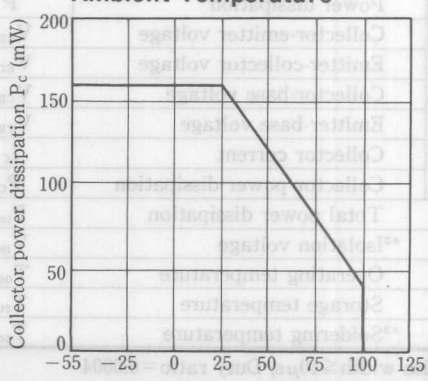


Fig. 3 Peak Forward Current vs. Duty Ratio

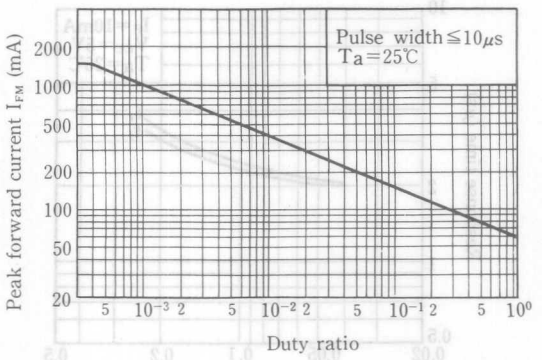


Fig. 4 Forward Current vs. Forward Voltage

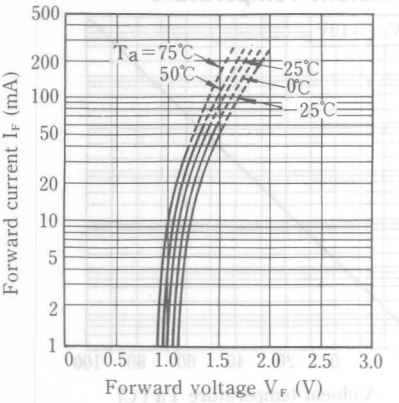


Fig. 5 Current Transfer Ratio vs. Forward Current

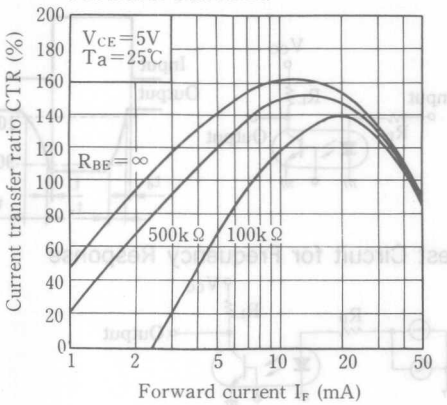


Fig. 6 Collector Current vs. Collector-emitter Voltage

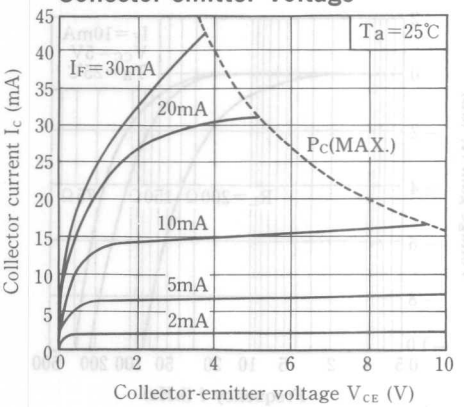


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

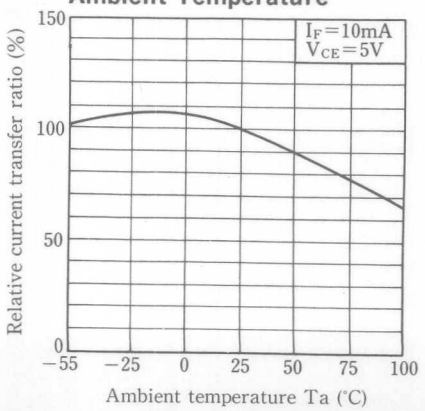
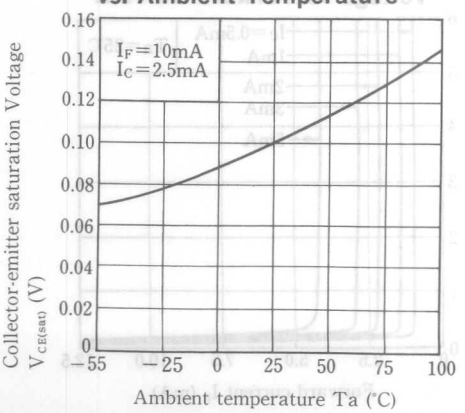


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature



6

Fig. 9 Collector Dark Current vs. Ambient Temperature

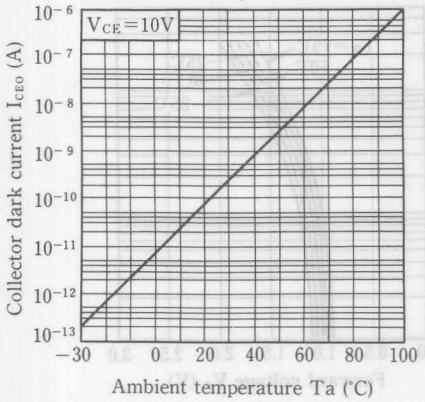


Fig. 10 Response Time vs. Load Resistance

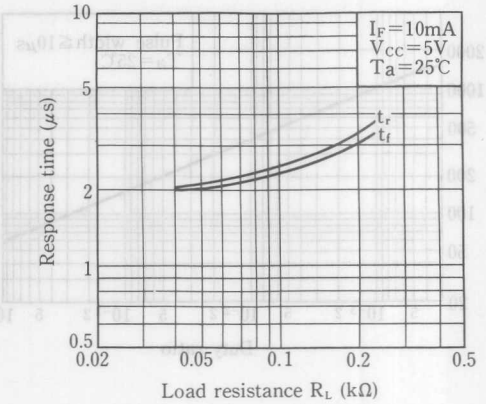
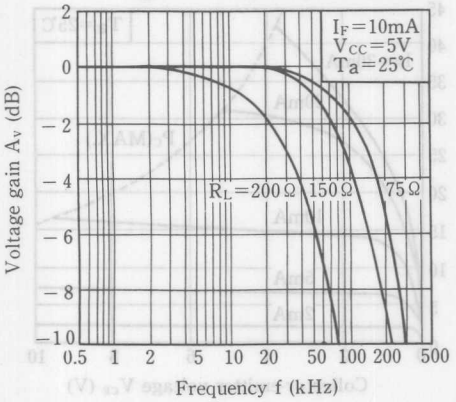
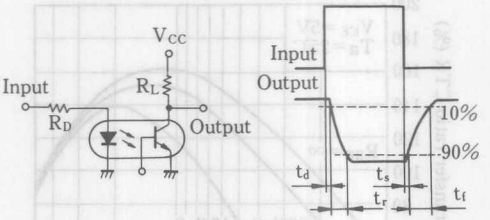


Fig. 11 Frequency Response



Test Circuit for Response Time



Test Circuit for Frequency Response

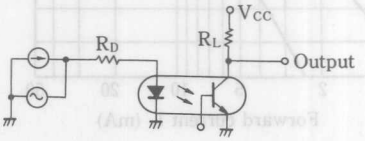
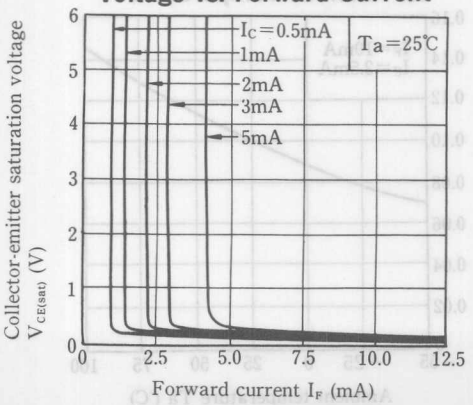


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



PC703V High Collector-emitter Voltage Type Photocoupler

*Lead forming type (I type) is also available (PC703VI) (Page 482)

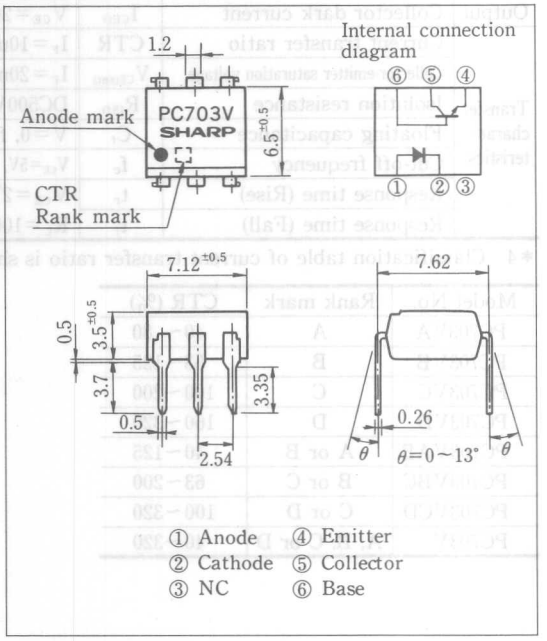
■ Features

1. High collector-emitter voltage (V_{CEO} : 70V)
2. High isolation voltage between input and ouoput (V_{iso} : 5,000Vrms)
3. TTL compatible output
4. UL recognized, file No. E64380, TÜV approved, No. R40181

■ Applications

1. Telephone sets, telephone exchangers
2. System appliances, measuring instruments
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward voltage	I_F	50	mA
	*1Peak forward voltage	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	70	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector-base voltage	V_{CBO}	70	V
	Emitter-base voltage	V_{EBO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	160	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30~+100	°C
Storage temperature		T_{stg}	−55~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0, R_{BE}=∞	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=10mA, V_{CE}=5V, R_{BE}=∞	40	—	320	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA, R_{BE}=∞	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω, R_{BE}=∞	—	80	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	4	15	μs
	Response time (Fall)	t_f	R_L=100Ω, R_{BE}=∞	—	3	15	μs

*4 Classification table of current transfer ratio is shown below.

Model No.	Rank mark	CTR (%)
PC703VA	A	40~ 80
PC703VB	B	63~125
PC703VC	C	100~200
PC703VD	D	160~320
PC703VAB	A or B	40~125
PC703VBC	B or C	63~200
PC703VCD	C or D	100~320
PC703V	A, B, C or D	40~320

Fig. 1 Forward Current vs. Ambient Temperature

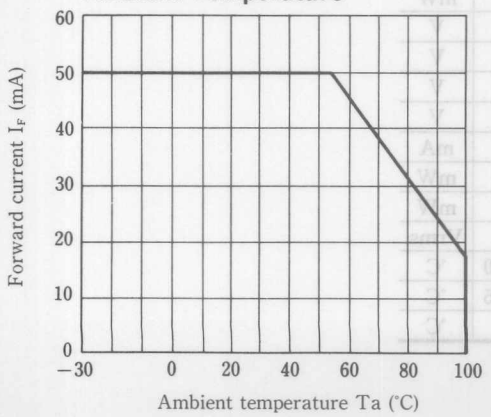


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

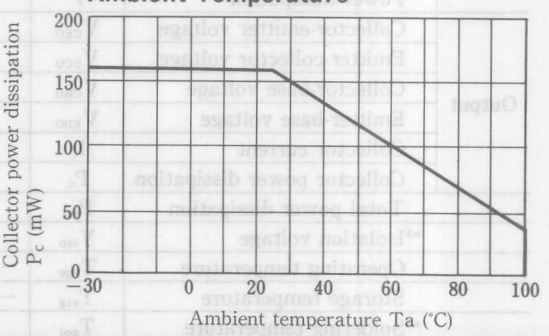


Fig. 3 Peak Forward Current vs. Duty Ratio

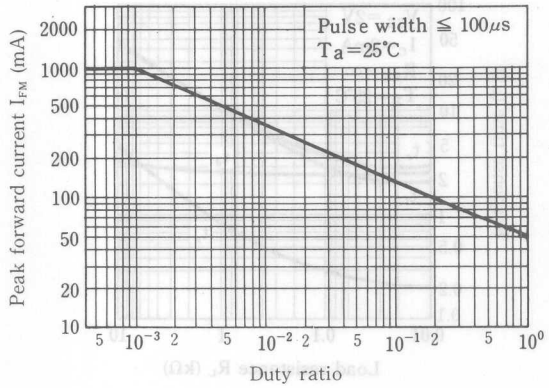


Fig. 4 Forward Current vs. Forward Voltage

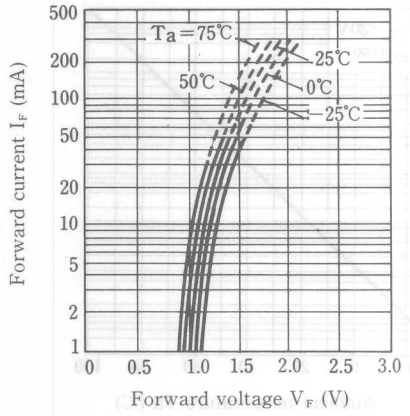


Fig. 5 Current Transfer Ratio vs. Forward Current

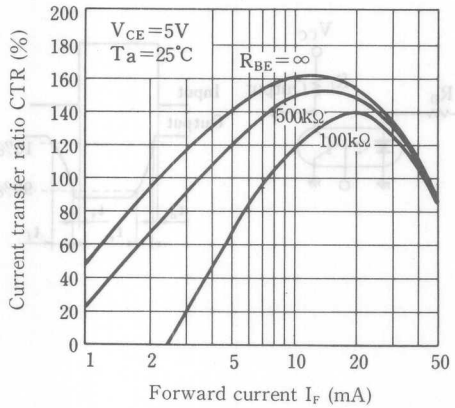


Fig. 6 Collector Current vs. Collector-emitter Voltage

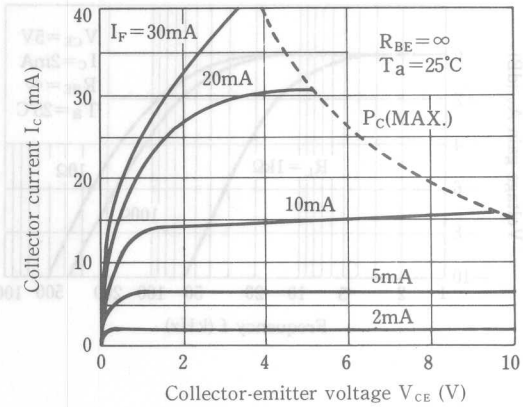


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

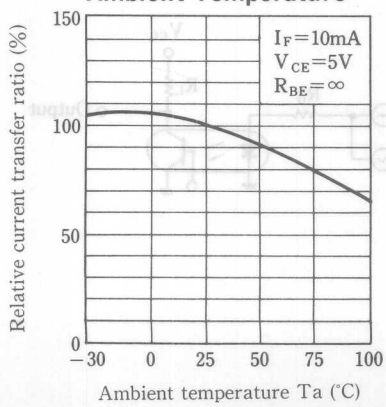
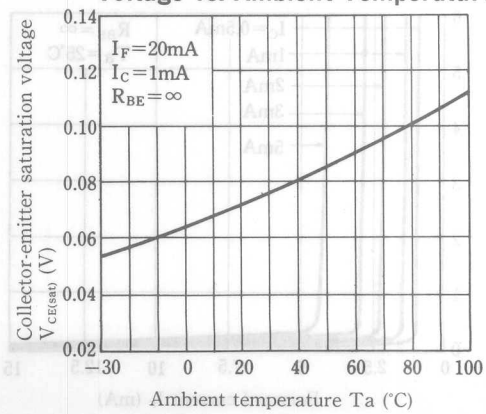


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature



6

Fig. 9 Collector Dark Current vs. Ambient Temperature

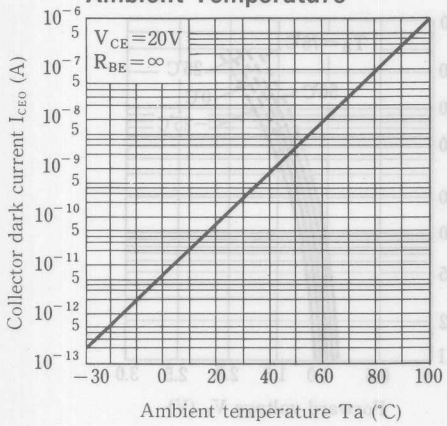


Fig. 10 Response Time vs. Load Resistance

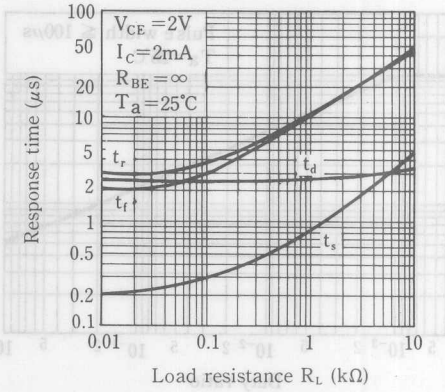
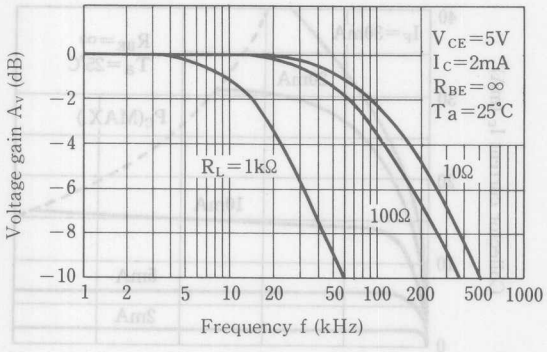


Fig. 11 Frequency Response



Test Circuit for Response Time

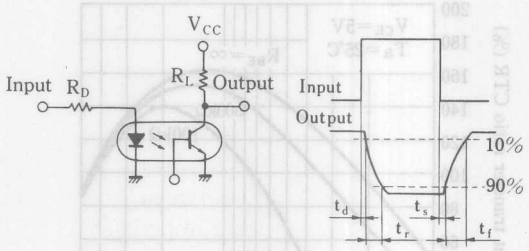
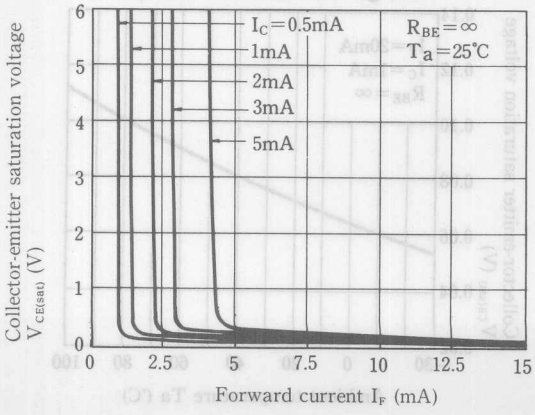
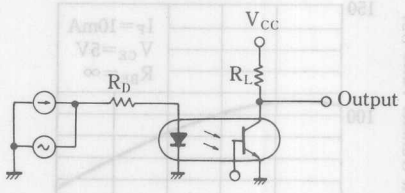


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



PC713V/PC714V High Isolation Voltage Type, General Purpose Photocoupler

※ Lead forming type (I type) of PC713V/PC714V is also available. (PC713VI/PC714VI) (Page 482).

■ Features

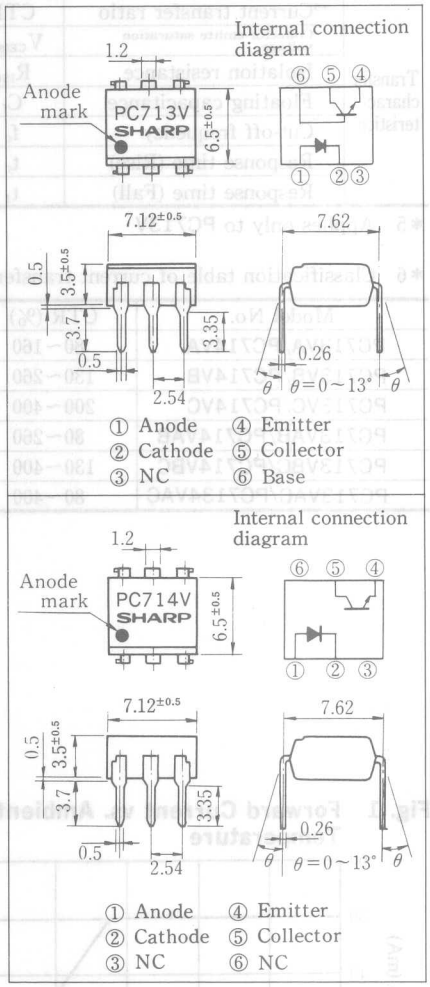
1. TTL compatible output
2. Current transfer ratio
   CTR: MIN. 50% at I_F=5mA, V_{CE}=5V
3. Low collector dark current
   (I_{CEO}: MAX. 10^{-7}A at V_{CE}=20V)
4. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
5. UL recognized, file No. E64380
   TÜV approved, No. R20036

■ Applications

1. System appliances, measuring instruments
2. Registers, copiers, automatic vending machines
3. Electric home appliances such as fan heaters
4. Medical instruments, physical and chemical equipment
5. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions

(Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	*2Collector-emitter voltage	V_{CBO}	35	V
	*2Emitter-base voltage	V_{EBO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
	Total power dissipation	P_{tot}	170	mW
	*3Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−25~+100	°C
	Storage temperature	T_{stg}	−40~+125	°C
	*4Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 Applies only to PC713V
*3 RH=40~60%, AC for 1 minute
*4 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0, *5R_{BE}=∞	—	—	10^{-7}	A
Transfer characteristics	*6Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V, *5R_{BE}=∞	50	100	600	%
	Collector-emitte saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA, *5R_{BE}=∞	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω, *5R_{BE}=∞	—	80	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	4	18	μs
	Response time (Fall)	t_f	R_L=100Ω, *5R_{BE}=∞	—	3	18	μs

*5 Applies only to PC713V

*6 Classification table of current transfer ratio is shown below.

Model No.	CTR (%)
PC713VA/PC714VA	80~160
PC713VB/PC714VB	130~260
PC713VC/PC714VC	200~400
PC713VAB/PC714VAB	80~260
PC713VBC/PC714VBC	130~400
PC713VAC/PC7134VAC	80~400

Fig. 1 Forward Current vs. Ambient Temperature

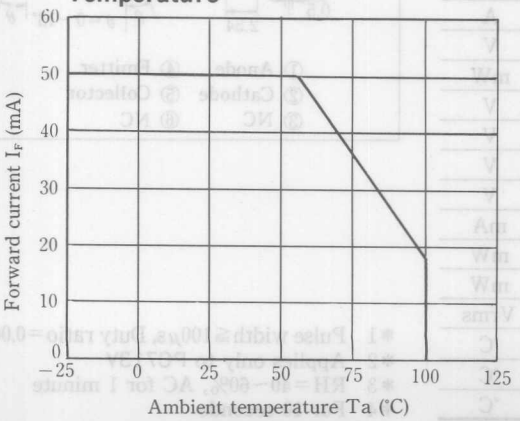


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

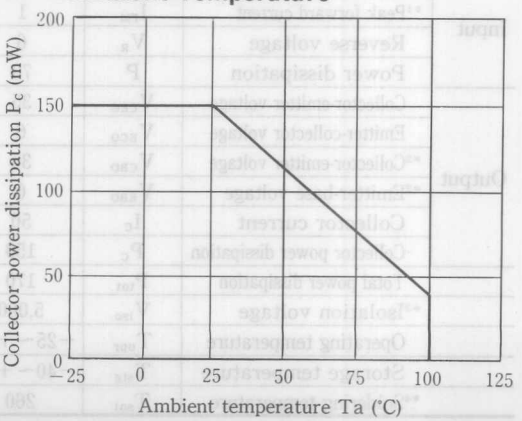


Fig. 3 Peak Forward Current vs. Duty Ratio

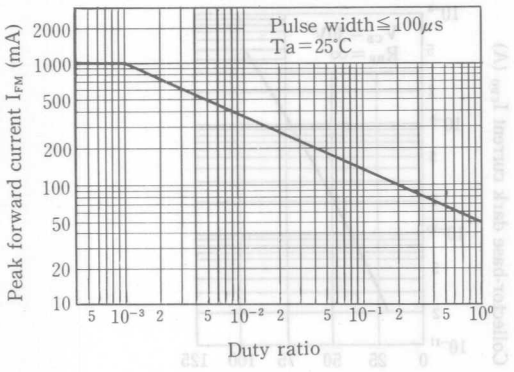


Fig. 4 Forward Current vs. Forward Voltage

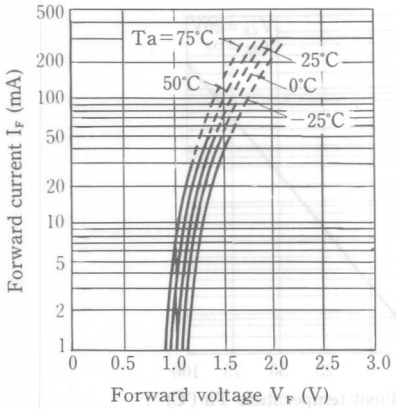


Fig. 5 Current Transfer Ratio vs. Forward Current

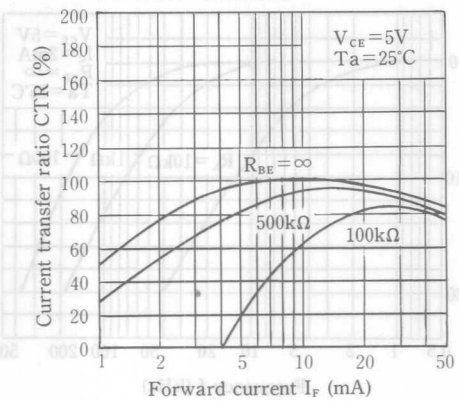


Fig. 6 Collector Current vs. Collector-emitter Voltage

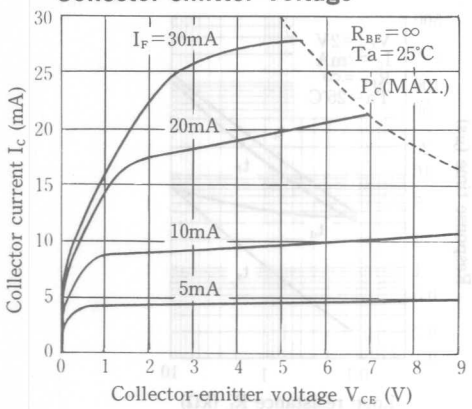


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

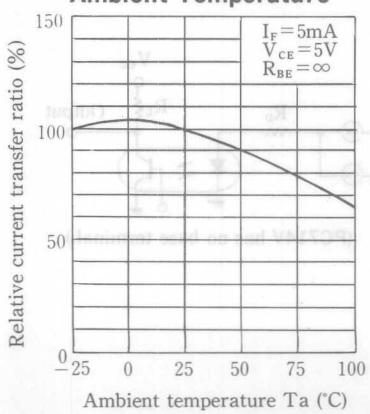
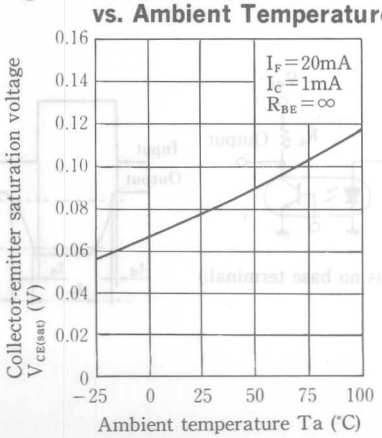


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature



6

Fig. 9 Collector Dark Current vs. Ambient Temperature

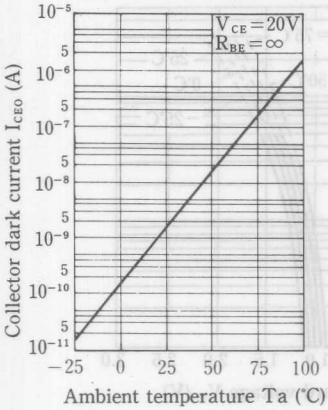


Fig. 10 Collector-base Dark Current vs. Ambient Temperature (Applies only to PC713V)

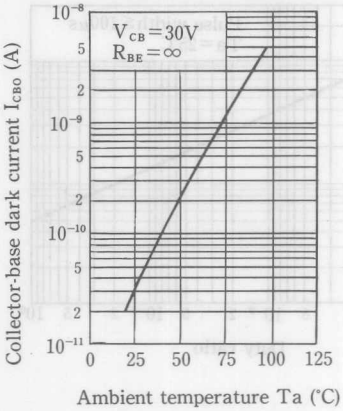


Fig. 11 Response Time vs. Load Resistance

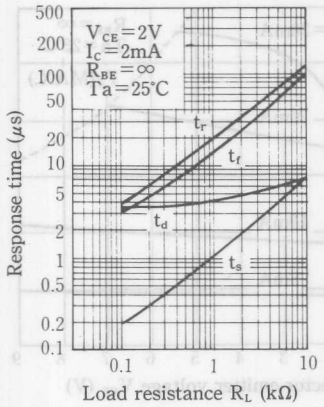
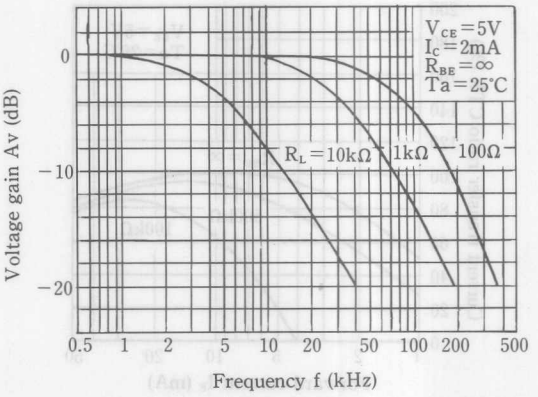
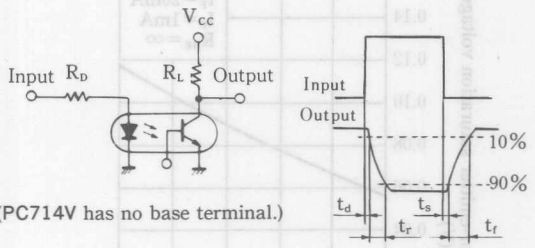


Fig. 12 Frequency Response

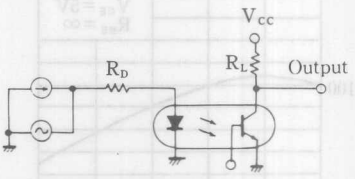


Test Circuit for Response Time



(PC714V has no base terminal.)

Test Circuit for Frequency Response



(PC714V has no base terminal.)

PC715V High Sensitivity Type Photocoupler

※ Lead forming type (I type) is also available. (PC715VI) (Page 482)

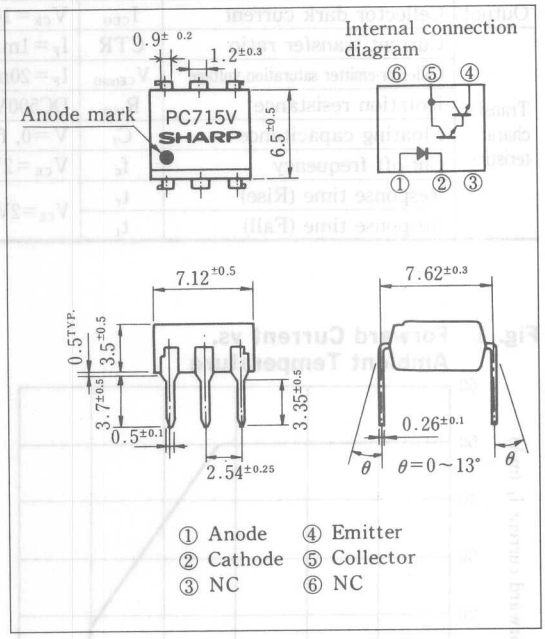
■ Features

1. High current transfer ratio
   (CTR : MIN. 600% at I_F=1mA, V_{CE}=2V)
2. High isolation voltage between input and output
   (V_{iso} : 5,000Vrms)
3. UL recognized, file No. E64380
   TÜV approved No. R20036

■ Applications

1. System appliances, measuring instruments
2. Copiers, automatic vending machines
3. Medical instruments
4. Signal transmission between circuits of differrent potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	80	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	170	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25～+100	°C
Storage temperature		T_{stg}	−40～+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward current	V_F	I_F=10mA	—	1.2	1.4	V
	Peak forward current	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse voltage	I_R	V_R=4V	—	—	10	μA
	Power dissipation	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=10V, I_F=0	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	600	1,600	7,500	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=5mA	—	—	1.0	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	6	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=10mA, R_L=100Ω	—	60	250	μs
	Response time (Fall)	t_f		—	53	250	μs

Fig. 1 Forward Current vs. Ambient Temperature

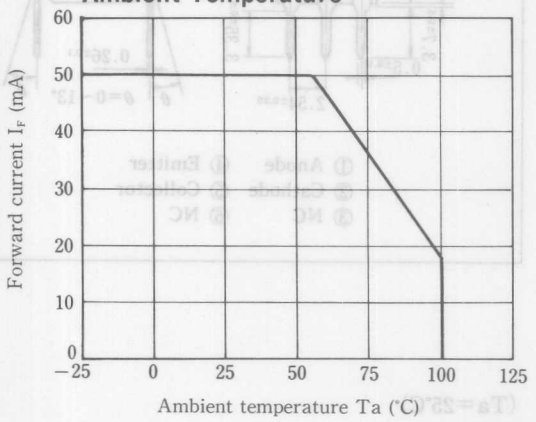


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

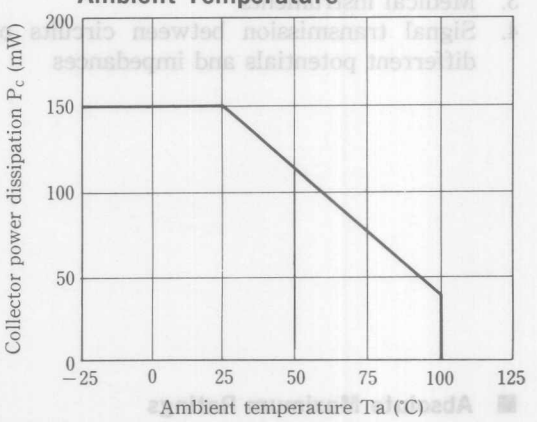


Fig. 3 Peak Forward Current vs. Duty Ratio

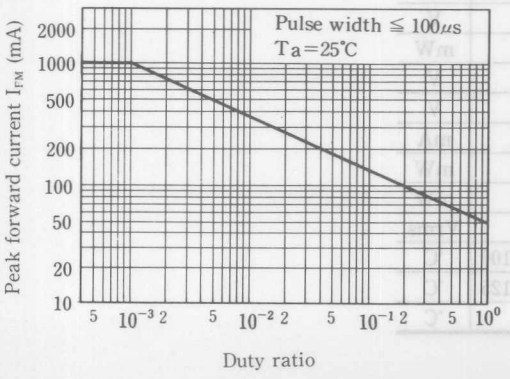


Fig. 4 Forward Current vs. Forward Voltage

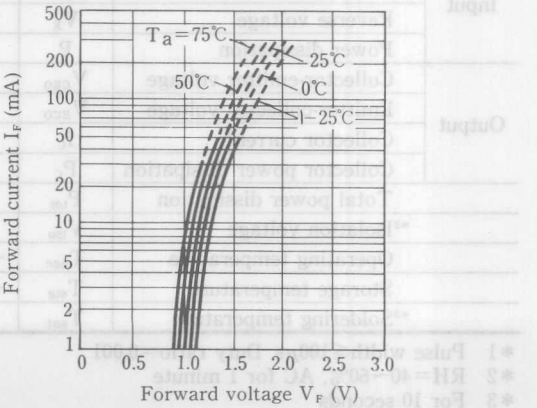


Fig. 5 Current Transfer Ratio vs. Forward Current

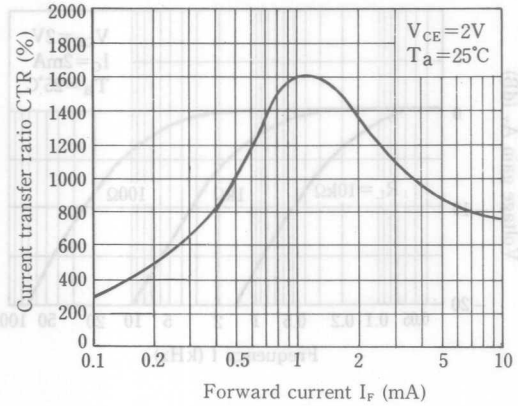


Fig. 6 Collector Current vs. Collector-emitter Voltage

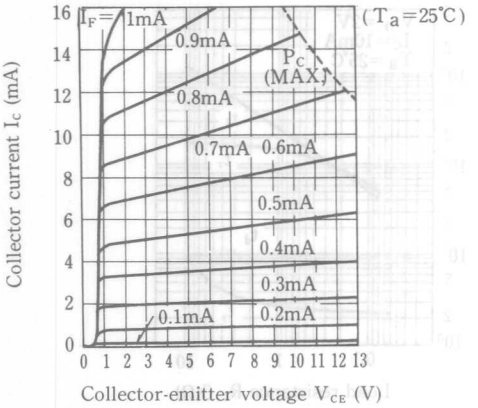


Fig. 7 Collector Current vs. Collector-emitter Voltage

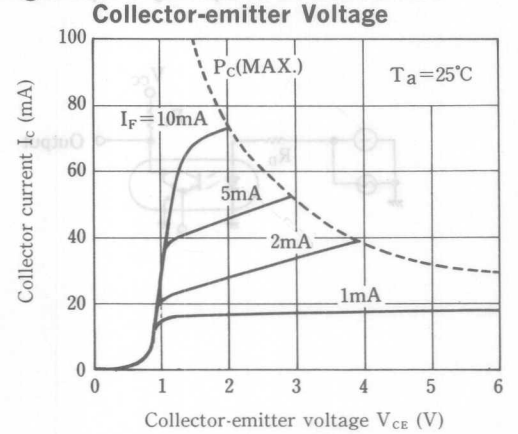


Fig. 8 Relative Current Transfer Ratio vs. Ambient Temperature

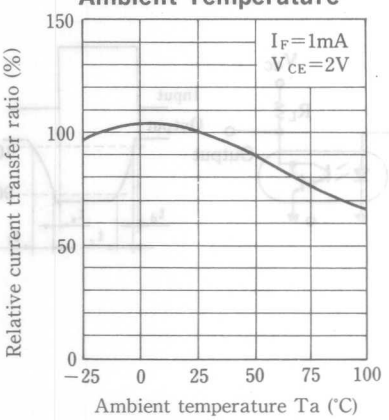


Fig. 9 Collector-emitter Saturation Voltage vs. Ambient Temperature

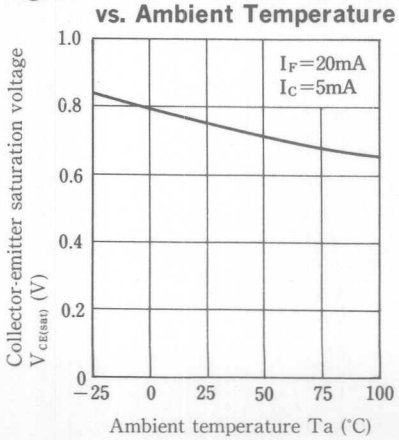
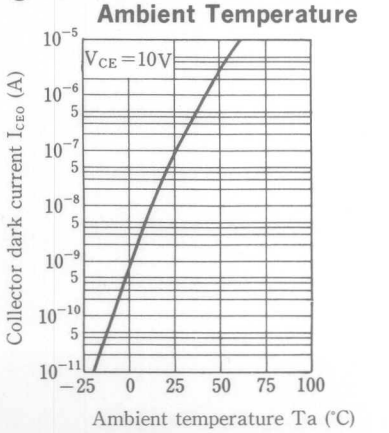


Fig. 10 Collector Dark Current vs. Ambient Temperature



6

Fig. 11 Response Time vs. Load Resistance

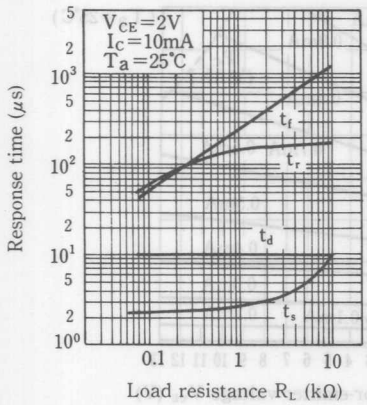
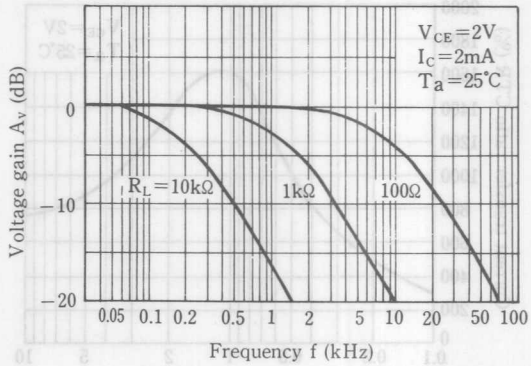
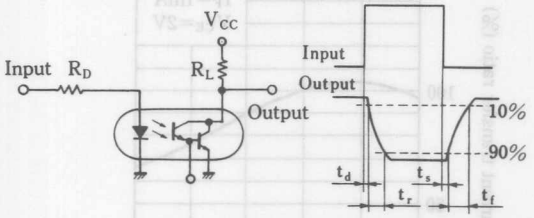


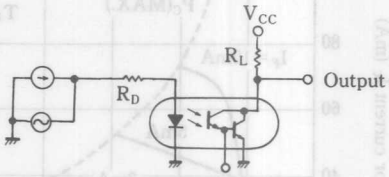
Fig. 12 Frequency Response



Test Circuit for Response Time



Test Circuit for Frequency Response



PC716V High Sensitivity, High Output Type Photocoupler

*Lead forming type (I type) is also available. (PC716VI) (Page 482)

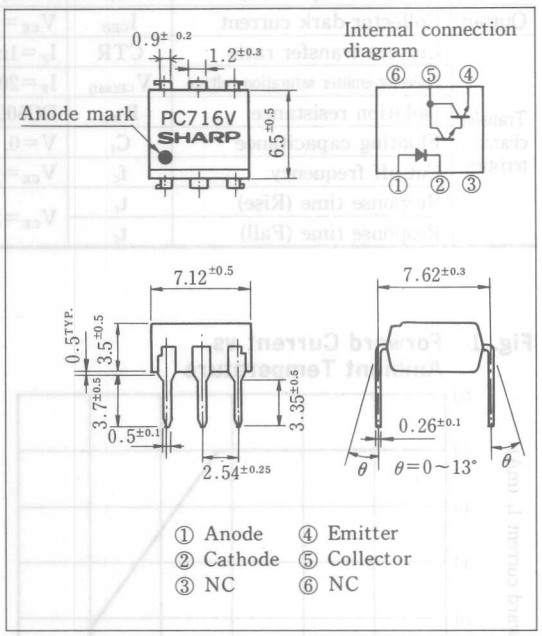
■ Features

1. High current transfer ratio
   (CTR: MIN. 1,000% at I_F=1mA, V_{CE}=2V)
2. High collector power dissipation
   (P_C: 300mW)
3. High isolation voltage between input and output
   (V_{iso}: 5,000Vrms)
4. UL recognized, file No. E64380
   TÜV approved No. R20036

■ Applications

1. DC-DC SSRs
2. Power monitors, welding machines
3. System appliances, measuring instruments
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	200	mA
	Collector power dissipation	P_C	300	mW
Total power dissipation		P_{tot}	350	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25~+100	°C
Storage temperature		T_{stg}	−40~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=10mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=10V, I_F=0	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	1,000	6,000	15,000	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=10mA	—	—	1.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=2V, I_C=10mA, R_L=100Ω	—	3	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=20mA, R_L=100Ω	—	130	400	μs
	Response time (Fall)	t_f		—	60	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

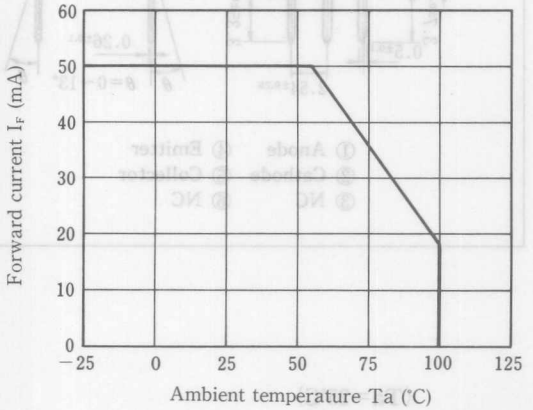


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

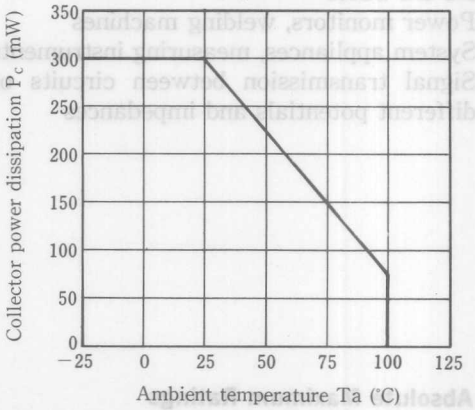


Fig. 3 Peak Forward Current vs. Duty Ratio

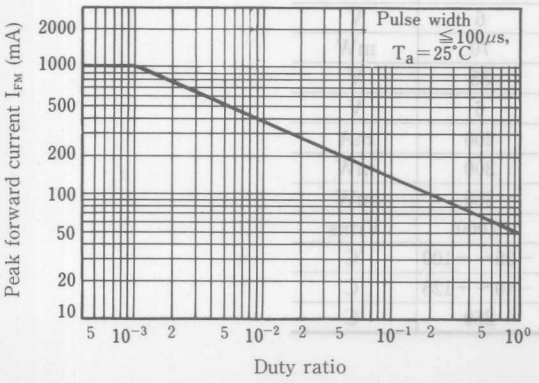


Fig. 4 Forward Current vs. Forward Voltage

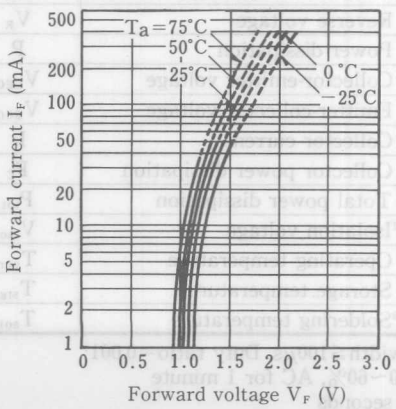


Fig. 5 Current Transfer Ratio vs. Forward Current

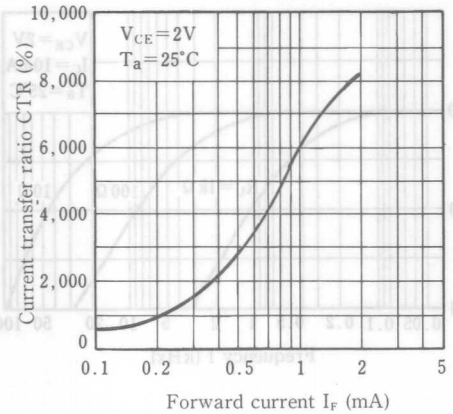


Fig. 6 Collector Current vs. Collector-emitter Voltage (1)

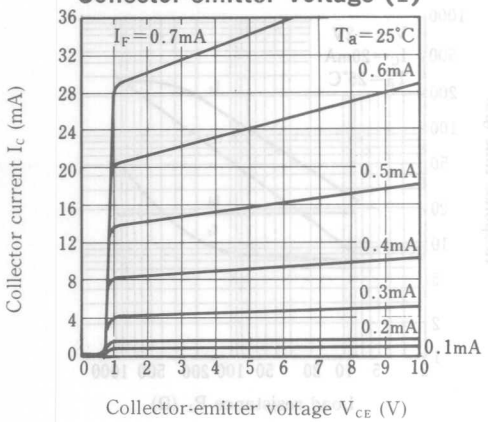


Fig. 7 Collector Current vs. Collector-emitter Voltage (2)

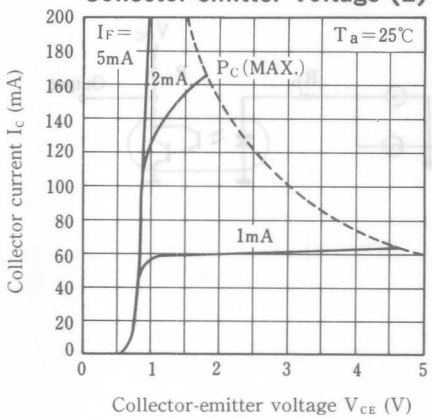


Fig. 8 Relative Current Transfer Ratio vs. Ambient Temperature

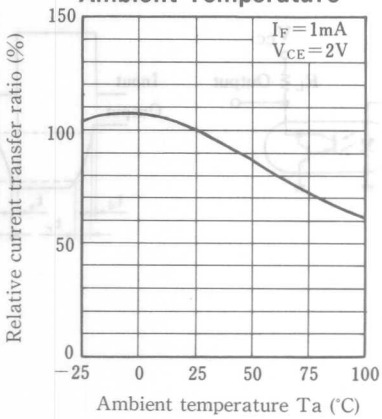


Fig. 9 Collector-emitter Saturation Voltage vs. Ambient Temperature

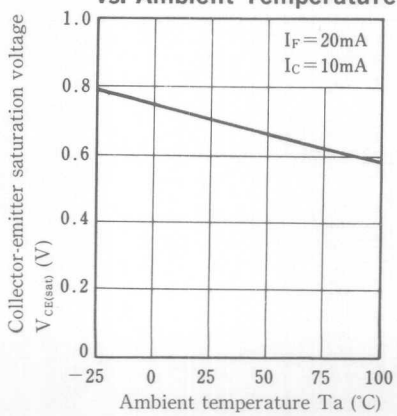
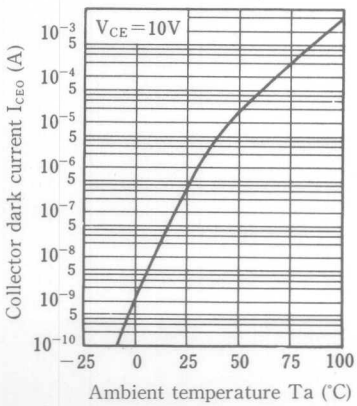


Fig. 10 Collector Dark Current vs. Ambient Temperature



6

Fig. 11 Rosponse Time vs. Load Resistance

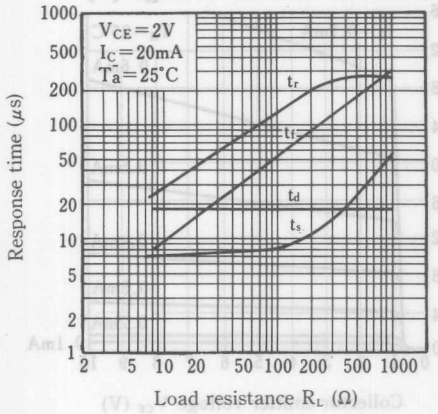
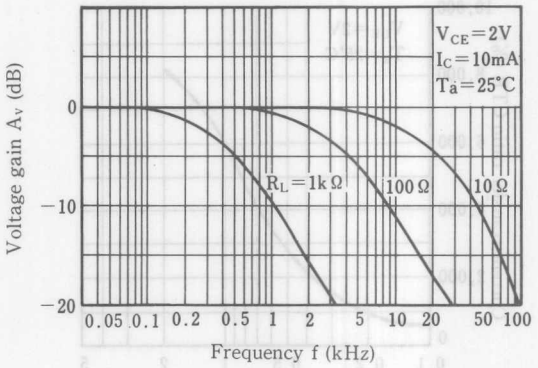
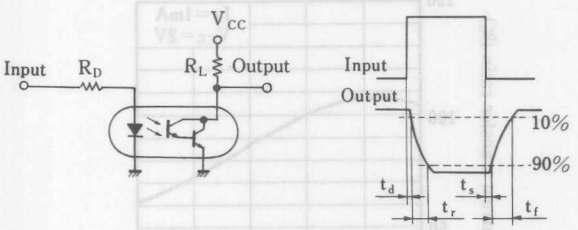


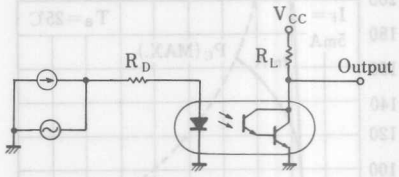
Fig. 12 Frequency Response



Test Circuit for Frequency Response



Test Circuit for Response Time



PC723V High Collector-emitter Voltage Type Photocoupler

※ Lead forming type (I type) of PC723V is also available. (PC723VI) (Page 482)

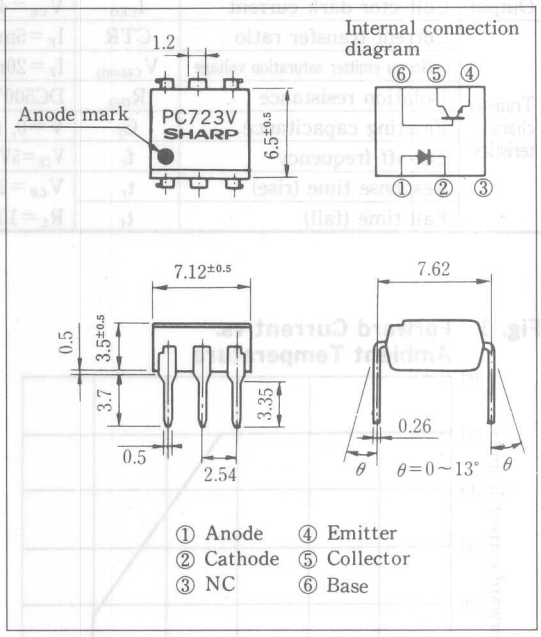
■ Features

1. High collector-emitter voltage (V_{CEO}: 80V)
2. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
3. Current transfer ratio
   CTR: MIN. 50% at I_F=5mA, V_{CE}=5V
4. TTL compatible output
5. UL recognized, file No. E64380
   TÜV approved, No. R20036

■ Applications

1. Telephone systems, telegram systems
2. System appliances, measuring instruments
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimension (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	80	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector-base voltage	V_{CBO}	130	V
	Emitter-base voltage	V_{EBO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25~+100	°C
Storage temperature		T_{stg}	−40~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=40V, I_F=0, R_{BE}=∞	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V, R_{BE}=∞	50	100	400	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA, R_{BE}=∞	—	0.1	0.3	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω, R_{BE}=∞	—	50	—	kHz
	Response time (rise)	t_r	V_{CE}=2V, I_C=2mA	—	6	20	μs
	Fall time (fall)	t_f	R_L=100Ω, R_{BE}=∞	—	7	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

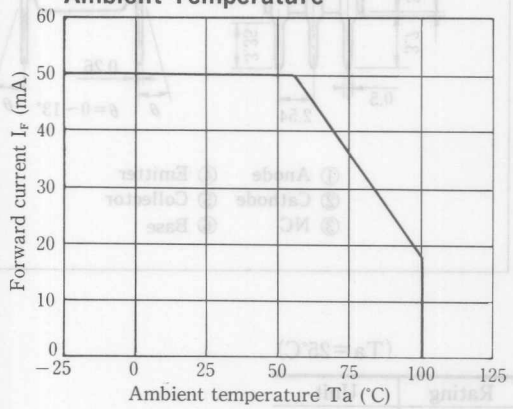


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

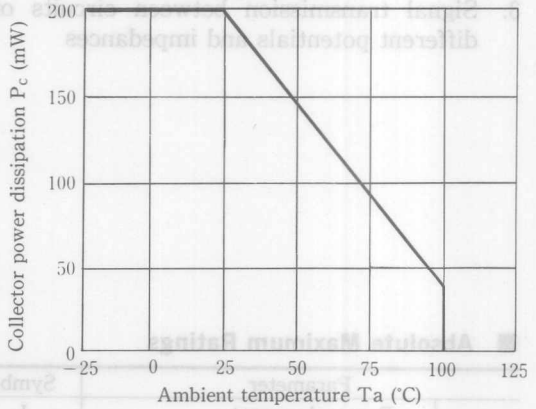


Fig. 3 Peak Forward Current vs. Duty Ratio

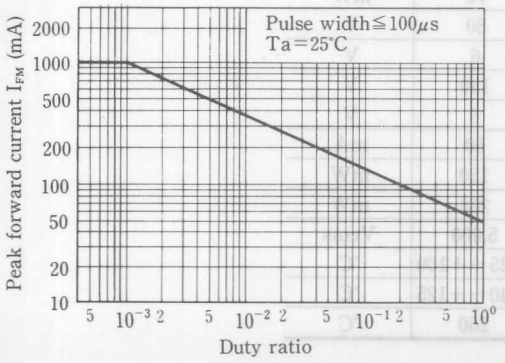


Fig. 4 Forward Current vs. Forward Voltage

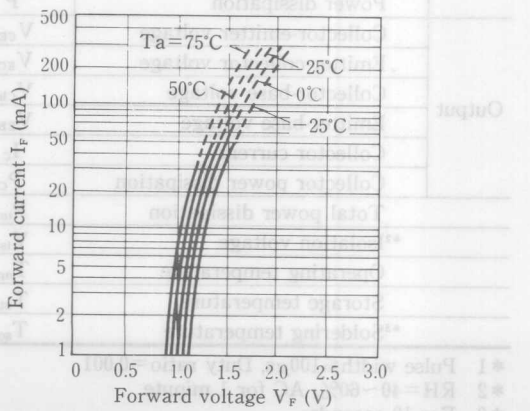


Fig. 5 Current Transfer Ratio vs. Forward Current

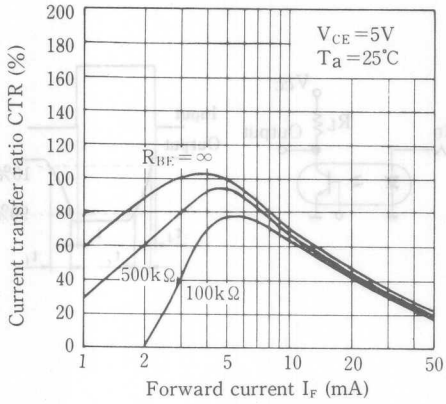


Fig. 6 Collector Current vs. Collector-emitter Voltage

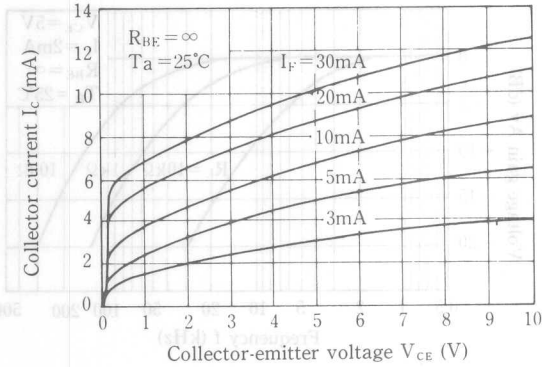


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

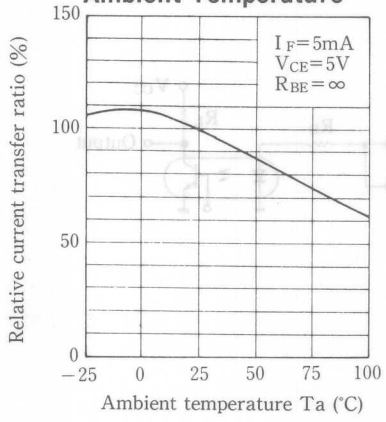


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

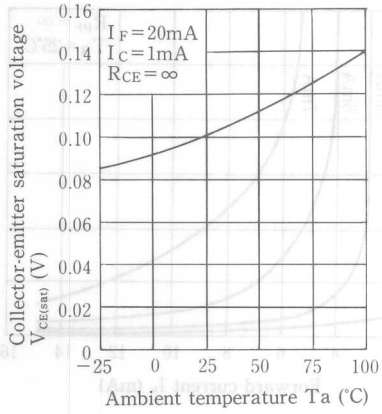


Fig. 9 Collector Dark Current vs. Ambient Temperature

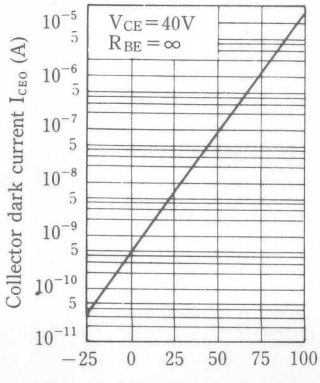
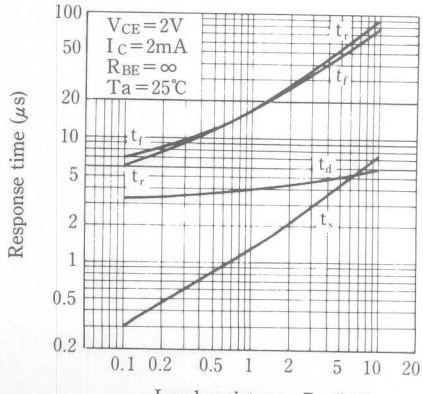
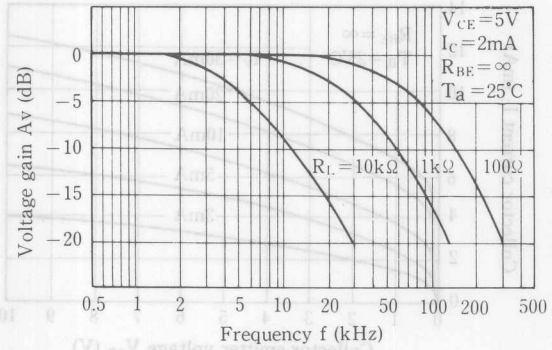


Fig. 10 Response Time vs. Load Resistance



6

Fig. 11 Frequency Response



Test Circuit for Response Time

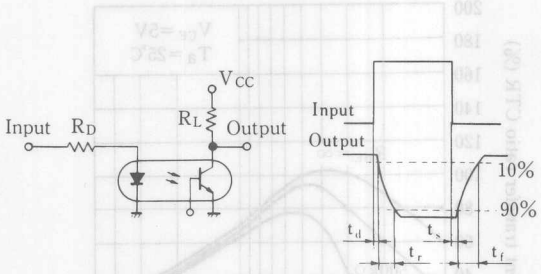
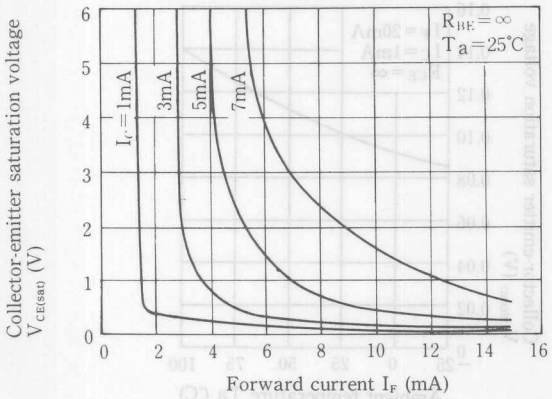
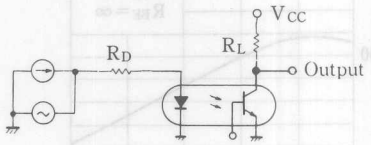


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



PC724V High Input Current Type Photocoupler

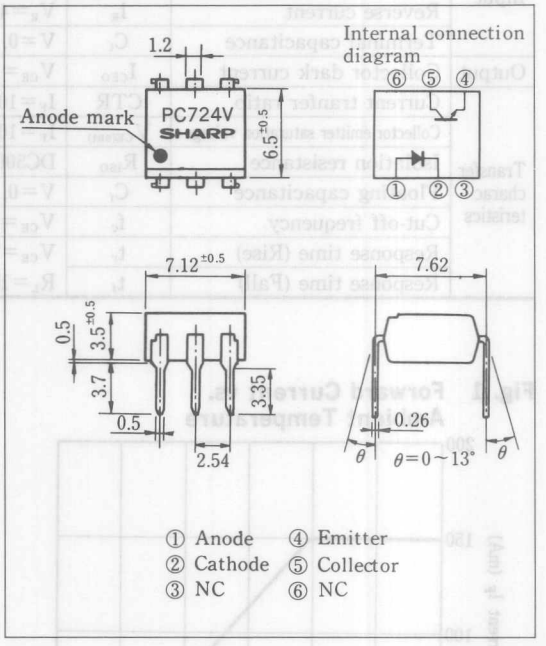
■ Features

1. High input current (I_F : MAX. 150mA)
2. High isolation voltage between input and output
   (V_{iso} : 5,000V_{rms})
3. Standard dual-in-line package

■ Applications

1. Telephone sets
2. I/O interfaces for microcomputer
3. System appliances, measuring instruments
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	150	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	230	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	80	mA
	Collector power dissipation	P_C	160	mW
	Total power dissipation	P_{tot}	320	mW
	*2Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−25~+100	°C
	Storage temperature	T_{stg}	−55~+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=100mA	—	1.4	1.7	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	Current tranfer ratio	CTR	I_F=100mA, V_{CE}=2V	20	—	80	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=100mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	1×10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω	—	100	—	kHz
	Response time (Rise)	t_r	V_{CE}=5V, I_C=2mA	—	4	18	μs
	Response time (Fall)	t_f	R_L=100Ω	—	3	18	μs

Fig. 1 Forward Current vs. Ambient Temperature

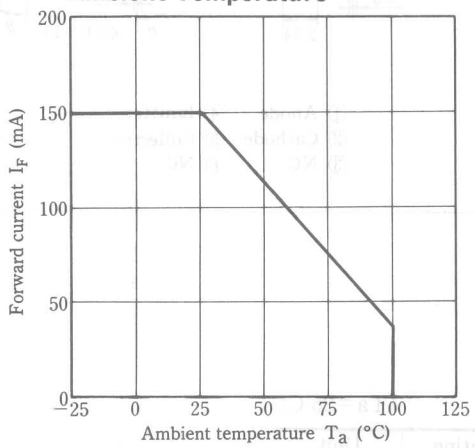


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

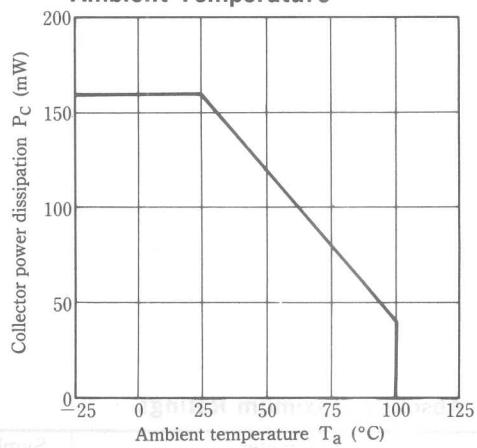


Fig. 3 Peak Forward Current vs. Duty Ratio

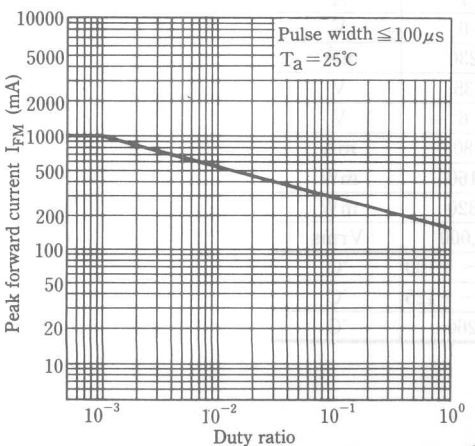


Fig. 4 Forward Current vs. Forward Voltage

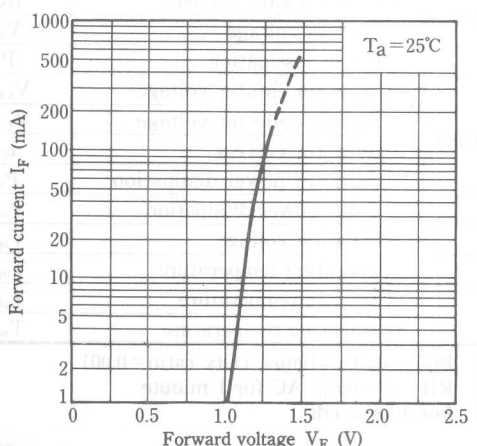


Fig. 5 Current Tranfer Ratio vs. Forward Current

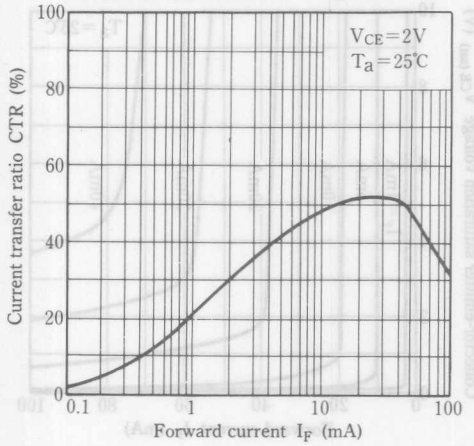


Fig. 6 Collector Current vs. Collector-emitter Voltage

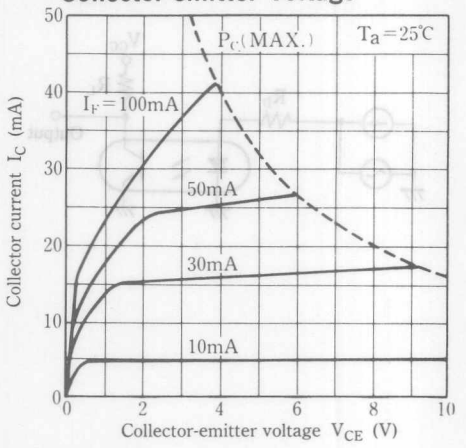


Fig. 7 Collector Dark Current vs. Ambient Temperature

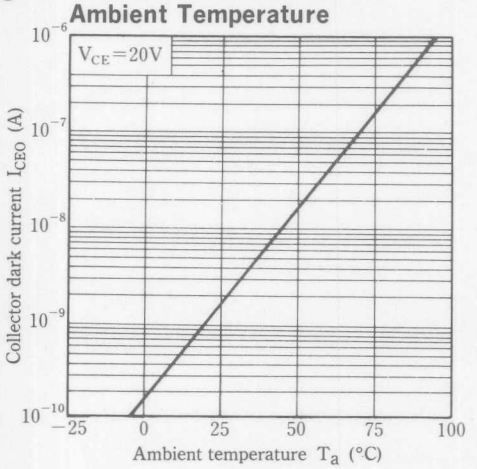


Fig. 8 Response Time vs. Load Resistance

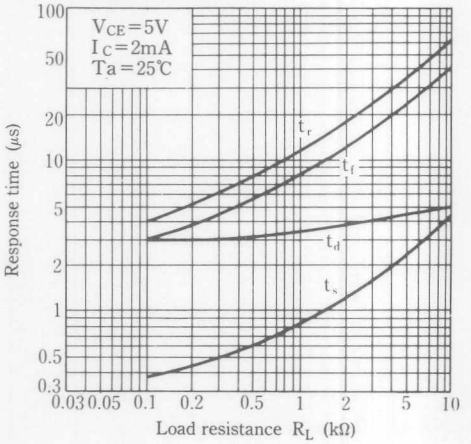
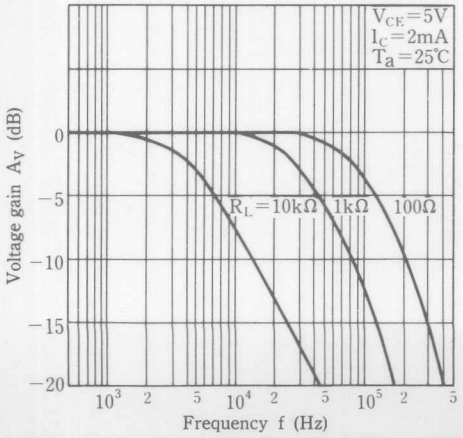
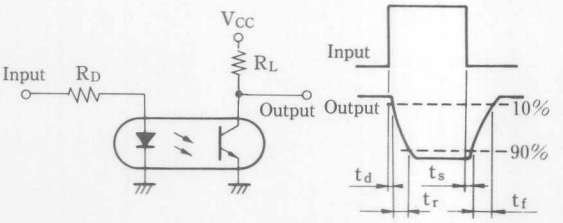


Fig. 9 Frequency Response



Test Circuit for Response Time



6

Test Circuit for Frequency Response

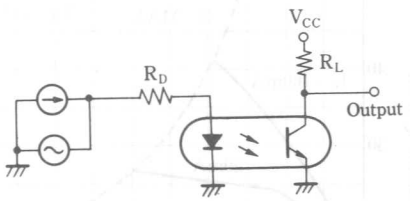
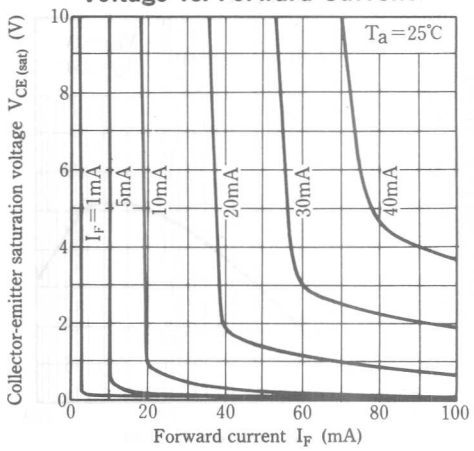


Fig. 10 Collector-emitter Saturation Voltage vs. Forward Current



PC725V High Sensitivity, High Collector-emitter Voltage Type Photocoupler

※ Lead forming type is also available. (PC725W) (Page 482)

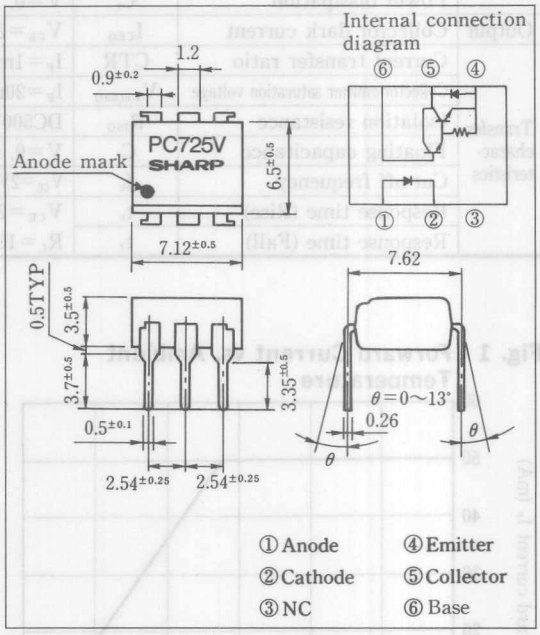
■ Features

1. High collector-emitter voltage (V_{CEO}: 300V)
2. High current transfer ratio (CTR: MIN. 1,000% at I_F=1mA, V_{CE}=2V)
3. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
4. Low collector dark current (I_{CEO}: MAX. 10^{-6}A at V_{CE}=200V)

■ Applications

1. Telephone sets, telephone exchangers
2. Power apparatus switchboards
3. Numerical control machines
4. DC-DC SSRs, DC motor controllers

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward voltage	I_F	50	mA
	*1Peak forward voltage	I_{FM}	1	A
	Reverse current	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	300	V
	Collector-base voltage	V_{CBO}	300	V
	Emitter-base voltage	V_{EBO}	6	V
	Collector current (forward)	I_C	150	mA
	Collector current (reverse)	I_C	−10	mA
	Collector power dissipation	P_C	300	mW
Total power dissipation		P_{tot}	350	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25~+100	°C
Storage temperature		T_{stg}	−40~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward current	V_F	I_F=10mA	—	1.2	1.4	V
	Peak forward current	V_{FM}	I_{FM}=0.5A	—	—	3	V
	Reverse voltage	I_R	V_R=4V	—	—	10	μA
	Power dissipation	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=200V, I_F=0, R_{BE}=∞	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V, R_{BE}=∞	1,000	4,000	15,000	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=100mA, R_{BE}=∞	—	—	1.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=2V, I_C=20mA, R_L=100Ω, R_{BE}=∞	1	7	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=20mA	—	100	300	μs
	Response time (Fall)	t_f	R_L=100Ω, R_{BE}=∞	—	20	100	μs

Fig. 1 Forward Current vs. Ambient Temperature

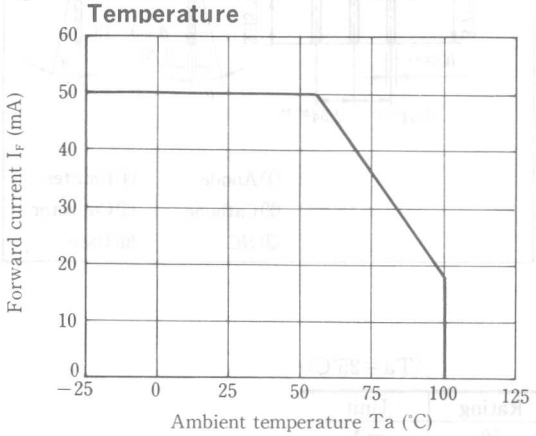


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

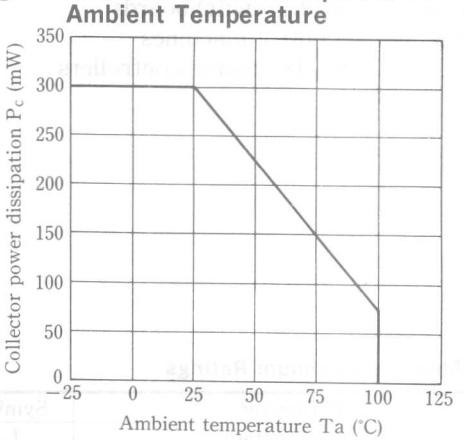


Fig. 3 Peak Forward Current vs. Duty Ratio

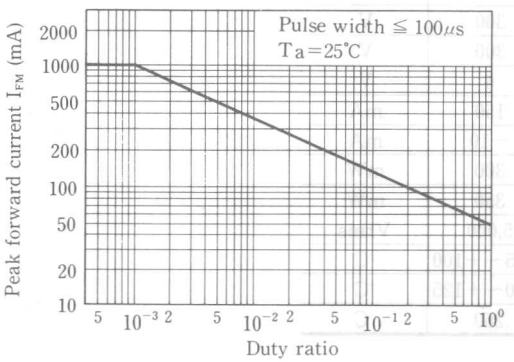


Fig. 4 Forward Current vs. Forward Voltage

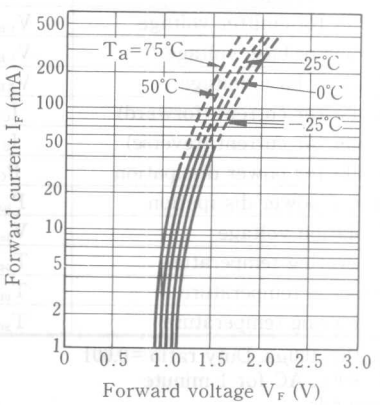


Fig. 5 Current Transfer Ratio vs. Forward Current

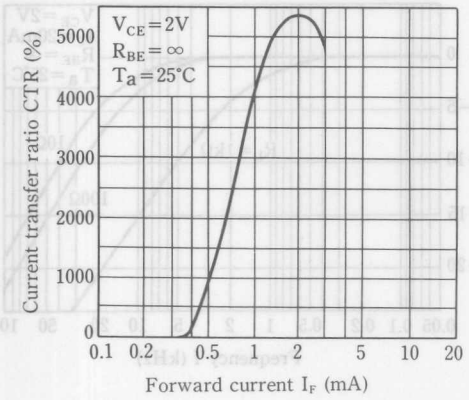


Fig. 6 Collector Current vs. Collector-emitter Voltage

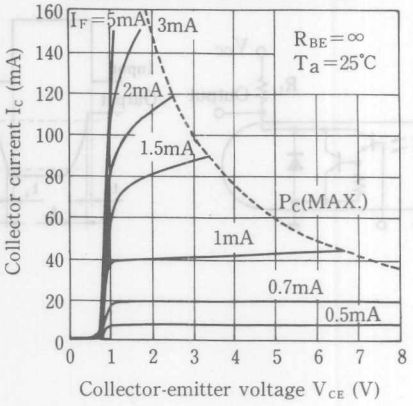


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

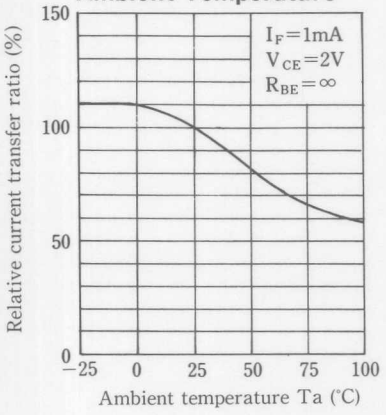


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

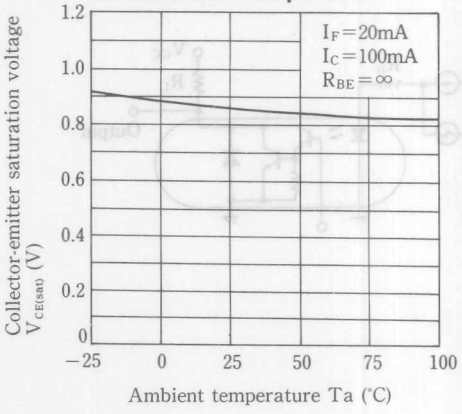


Fig. 9 Collector Dark Current vs. Ambient Temperature

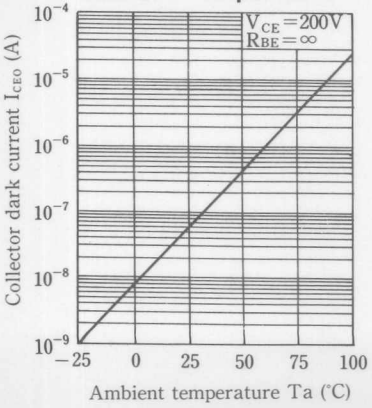
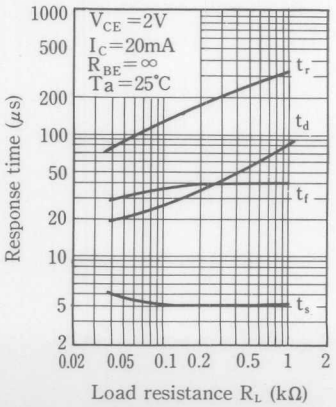


Fig. 10 Response Time vs. Load Resistance



6

Test Circuit for Response Time

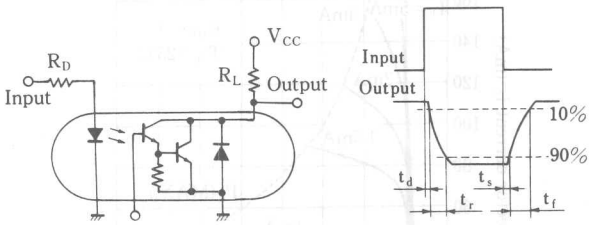
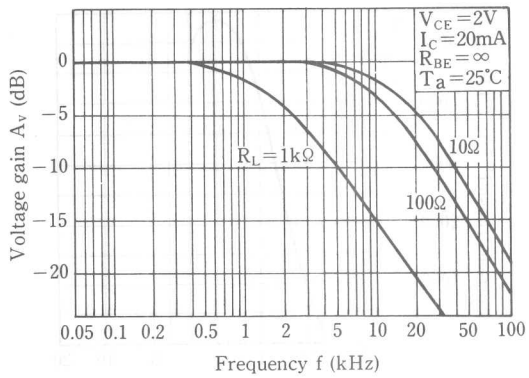
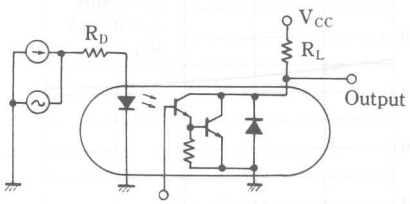


Fig. 11 Frequency Response



Test Circuit for Frequency Response



PC733 AC Input Type Photocoupler

※ Lead forming type (I type) is also available. (PC733I) (Page 482)

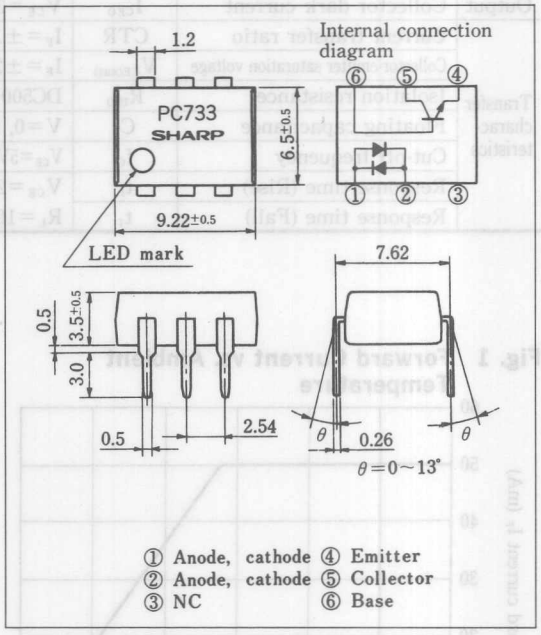
■ Features

1. AC input response
2. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
3. Current transfer ratio
   CTR: MIN. 15% at $I_F = \pm 1$mA, $V_{CE} = 5$V
4. Low collector dark current
   (I_{CEO}: MAX. 10^{-7}A at $V_{CE} = 20$V)
5. TTL compatible output
6. UL recognized, file No. E64380

■ Applications

1. Telephone sets
2. Programmable controllers
3. System appliances, measuring instruments
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	±50	mA
	*1Peak forward current	I_{FM}	±1	A
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector-base voltage	V_{CBO}	35	V
	Emitter-base voltage	V_{EBO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	170	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25~+100	°C
Storage temperature		T_{stg}	−40~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	$I_F=\pm20$mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	$I_{FM}=\pm0.5$A	—	—	3.0	V
	Terminal capacitance	C_t	V=0, f=1kHz	—	50	400	pF
Output	Collector dark current	I_{CEO}	$V_{CE}=20$V, $I_F=0$, $R_{BE}=\infty$	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	$I_F=\pm1$mA, $V_{CE}=5$V, $R_{BE}=\infty$	15	—	300	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_F=\pm20$mA, $I_C=1$mA, $R_{BE}=\infty$	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_C	$V_{CE}=5$V, $I_C=2$mA, $R_L=100$Ω, $R_{BE}=\infty$	15	80	—	kHz
	Response time (Rise)	t_r	$V_{CE}=2$V, $I_C=2$mA	—	4	18	μs
	Response time (Fall)	t_f	$R_L=100$Ω, $R_{BE}=\infty$	—	3	18	μs

Fig. 1 Forward Current vs. Ambient Temperature

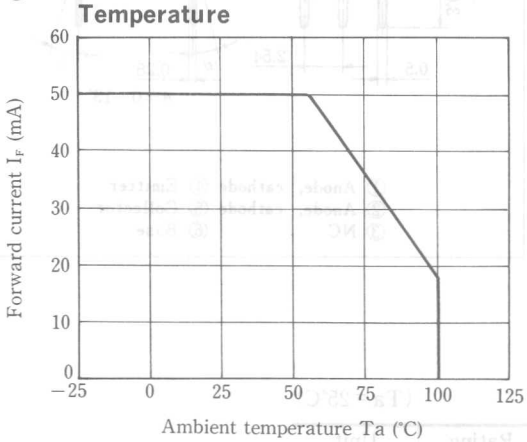


Fig. 2 Diode Power Dissipation vs. Ambient Temperature

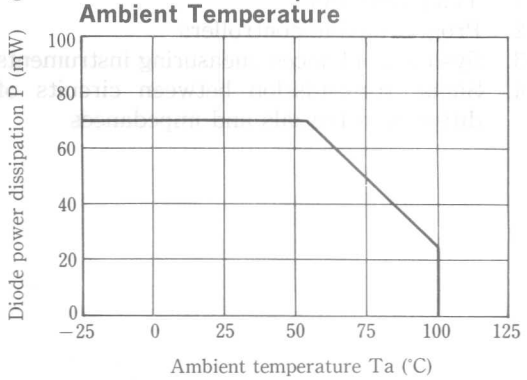


Fig. 3 Collector Power Dissipation vs. Ambient Temperature

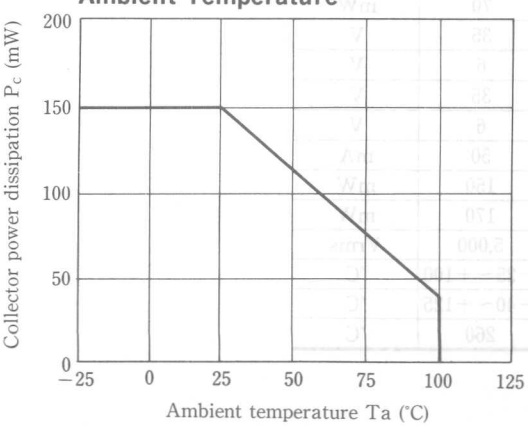


Fig. 4 Total Power Dissipation vs. Ambient Temperature

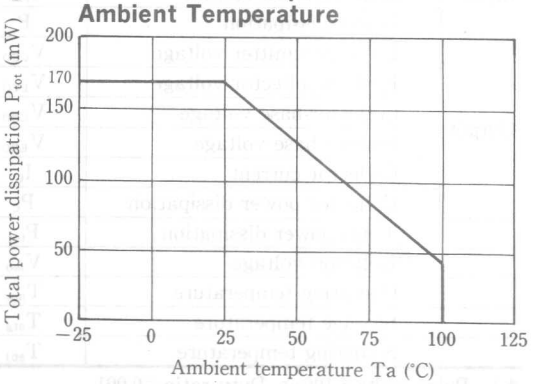


Fig. 5 Peak Forward Current vs. Duty Ratio

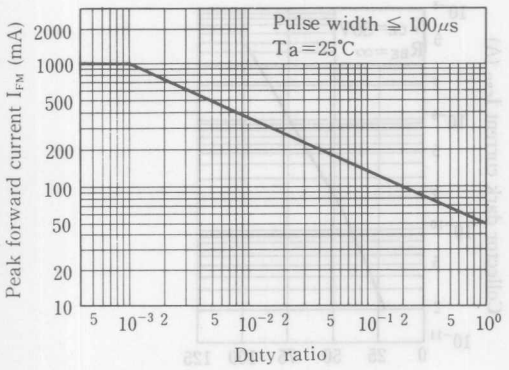


Fig. 6 Forward Current vs. Forward Voltage

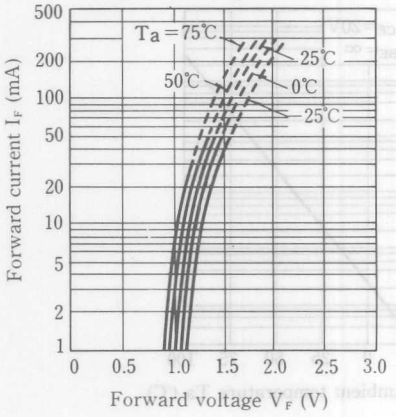


Fig. 7 Current Transfer Ratio vs. Forward Current

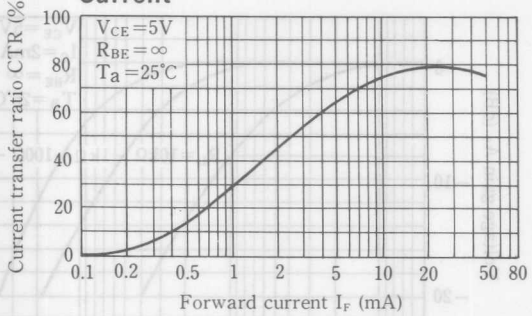


Fig. 8 Collector Current vs. Collector-emitter Voltage

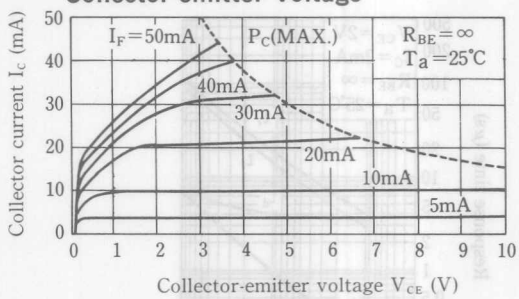


Fig. 9 Relative Current Transfer Ratio vs. Ambient Temperature

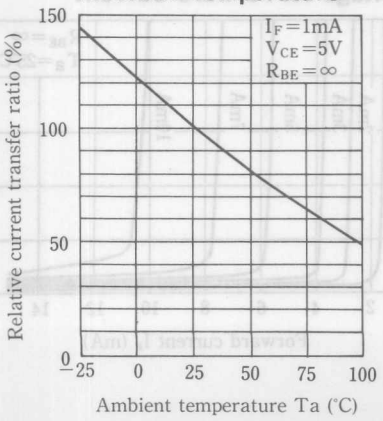
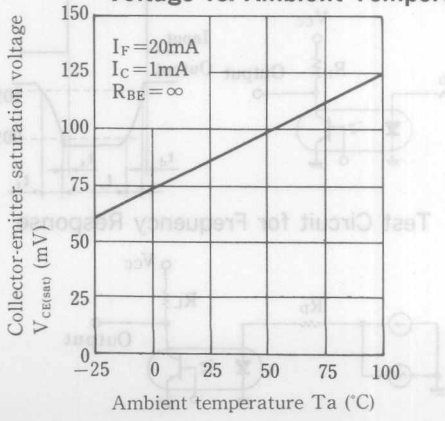


Fig. 10 Collector-emitter Saturation Voltage vs. Ambient Temperature



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Fig. 11 Collector Dark Current vs. Ambient Temperature (1)

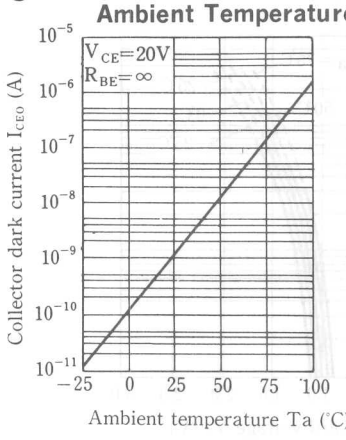


Fig. 12 Collector Dark Current vs. Ambient Temperature (2)

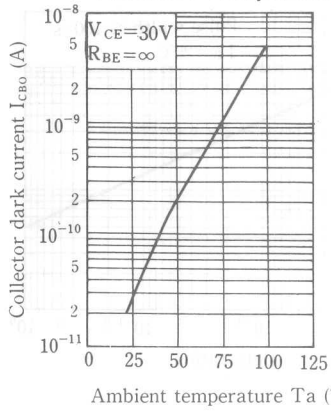


Fig. 13 Response Time vs. Load Resistance

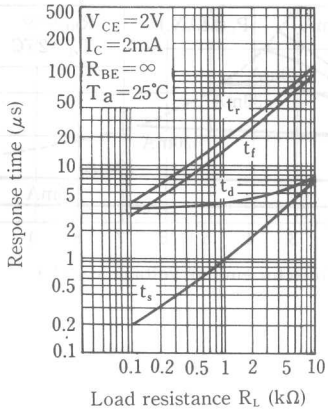
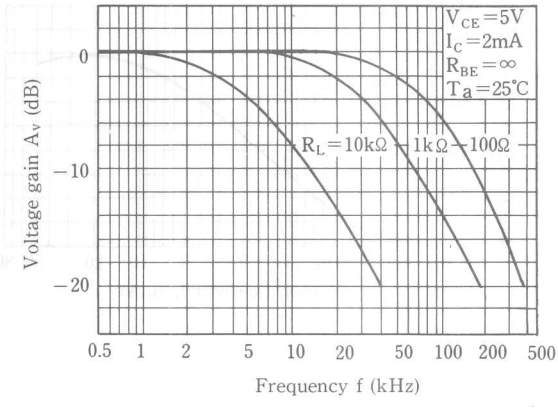
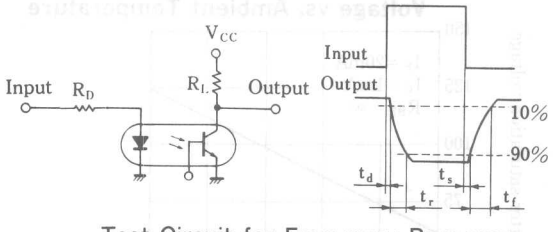


Fig. 14 Frequency Response



Test Circuit for Response Time



Test Circuit for Frequency Response

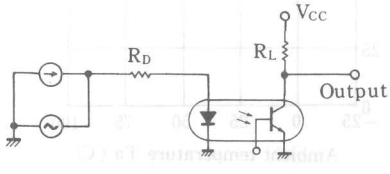
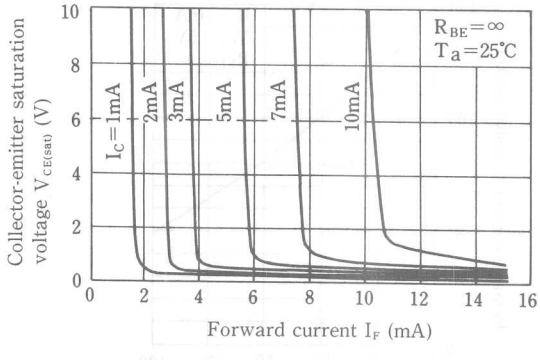


Fig. 15 Collector-emitter Saturation Voltage vs. Forward Current



PC733H High Input Current, AC Input Type Photocoupler

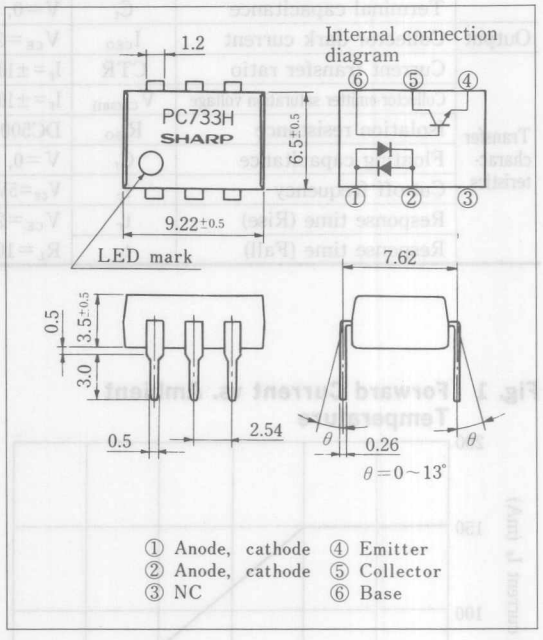
■ Features

1. AC polarity insensitive inputs
2. High input current (I_F: MAX. 150mA)
3. High isolation voltage between input and output
   (V_{iso}: 5,000Vrms)
4. Low collector dark current
   (I_{CEO}: MAX. 10^{-7}A at V_{CE}=20V)
5. TTL compatible output
6. UL recognized, file No. E64380

■ Applications

1. Telephone sets
2. System appliances, measuring instruments
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	±150	mA
	*1Peak forward current	I_{FM}	±1	A
	Power dissipation	P	230	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector-base voltage	V_{CBO}	35	V
	Emitter-base voltage	V_{EBO}	6	V
	Collector current	I_C	80	mA
	Collector power dissipation	P_C	160	mW
	Total power dissipation	P_{tot}	320	mW
	*2Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−25~+100	°C
	Storage temperature	T_{stg}	−55~+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	$I_F=\pm100mA$	—	1.4	1.7	V
	Peak forward voltage	V_{FM}	$I_{FM}=\pm0.5A$	—	—	3.0	V
	Terminal capacitance	C_t	V=0, f=1kHz	—	50	400	pF
Output	Collector dark current	I_{CEO}	$V_{CE}=20V$, $I_F=0$, $R_{BE}=\infty$	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	$I_F=\pm100mA$, $V_{CE}=2V$, $R_{BE}=\infty$	20	—	80	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_F=\pm100mA$, $I_C=1mA$, $R_{BE}=\infty$	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MH.	—	0.6	1.0	pF
	Cut-off frequency	f_c	$V_{CE}=5V$, $I_C=2mA$, $R_L=100\Omega$, $R_{BE}=\infty$	15	80	—	kHz
	Response time (Rise)	t_r	$V_{CE}=2V$, $I_C=2mA$,	—	4	18	μs
	Response time (Fall)	t_f	$R_L=100\Omega$, $R_{BE}=\infty$	—	3	18	μs

Fig. 1 Forward Current vs. Ambient Temperature

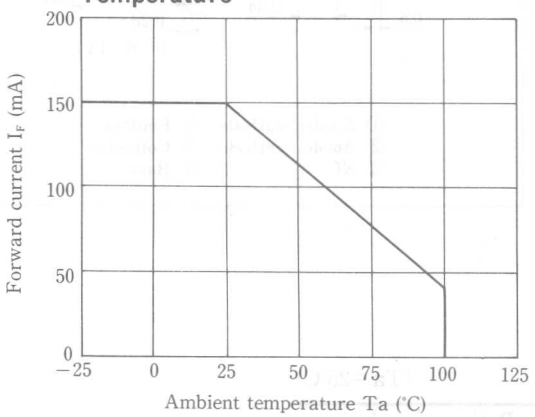


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

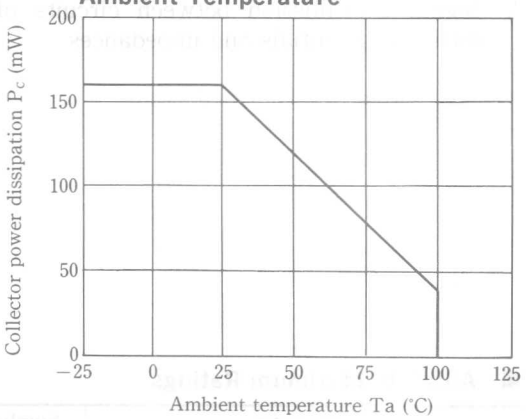


Fig. 3 Peak Forward Current vs. Duty Ratio

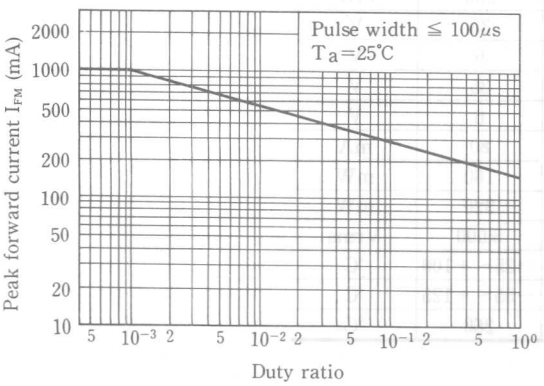


Fig. 4 Forward Current vs. Forward Voltage

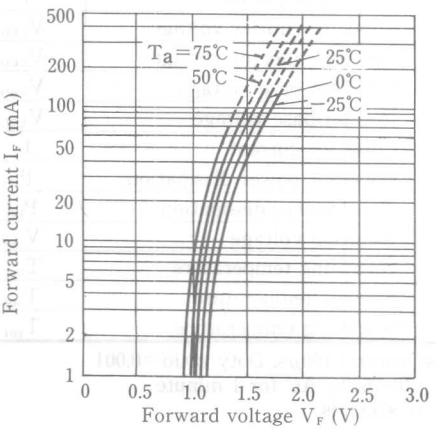


Fig. 5 Current Transfer Ratio vs. Forward Current

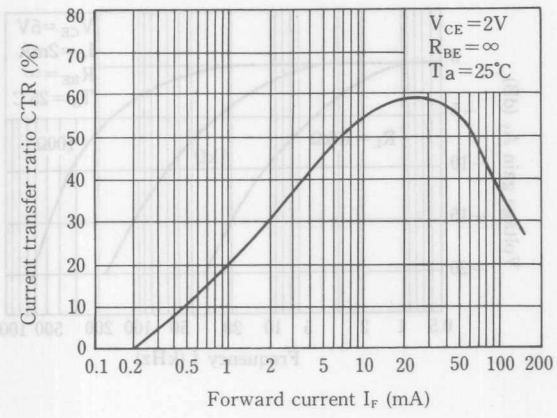


Fig. 6 Collector Current vs. Collector-emitter Voltage

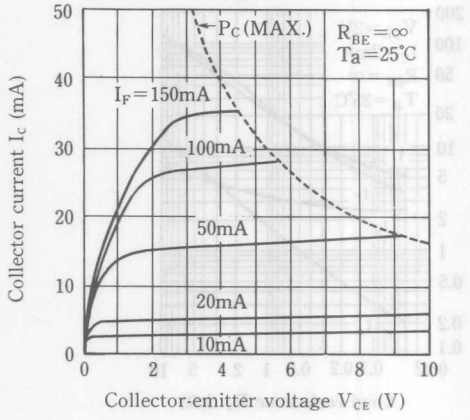


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

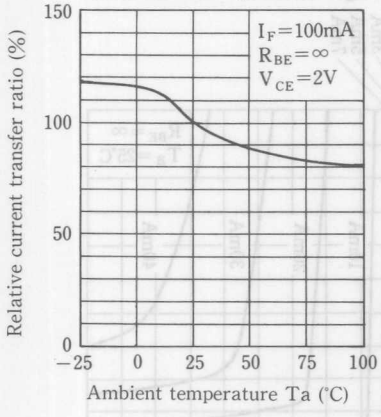


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

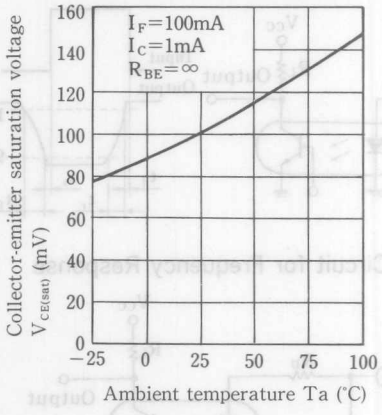


Fig. 9 Collector Dark Current vs. Ambient Temperature (1)

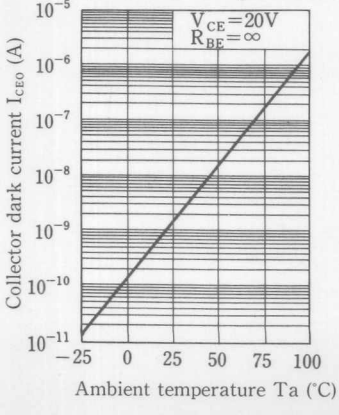
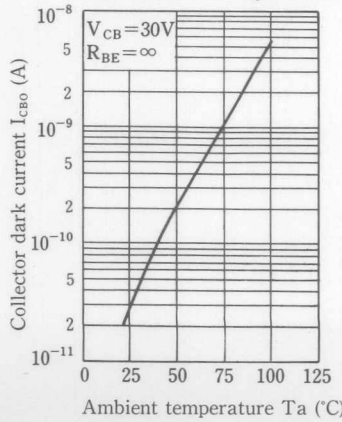


Fig. 10 Collector Dark Current vs. Ambient Temperature (2)



6

Fig. 11 Response Time vs. Load Resistance

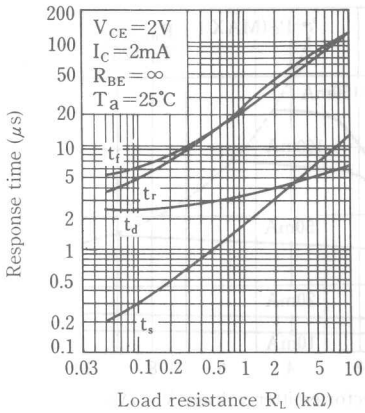
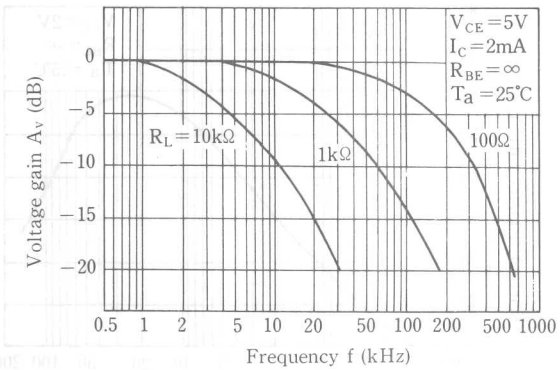
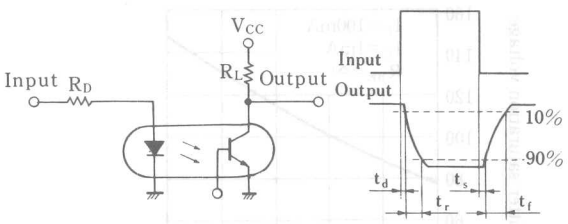


Fig. 12 Frequency Response



Test Circuit for Response Time



Test Circuit for Frequency Response

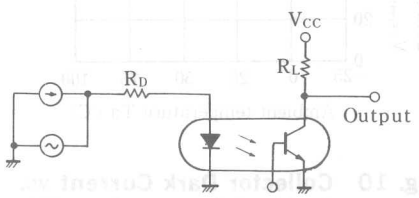
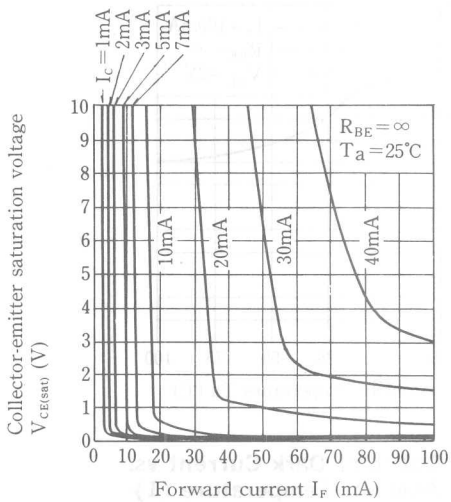


Fig. 13 Collector-emitter Saturation Voltage vs. Forward Current



PC810 High Speed Under High Load Resistance Photocoupler

※ Lead forming type (I type) is also available. (PC810I) (Page 482)

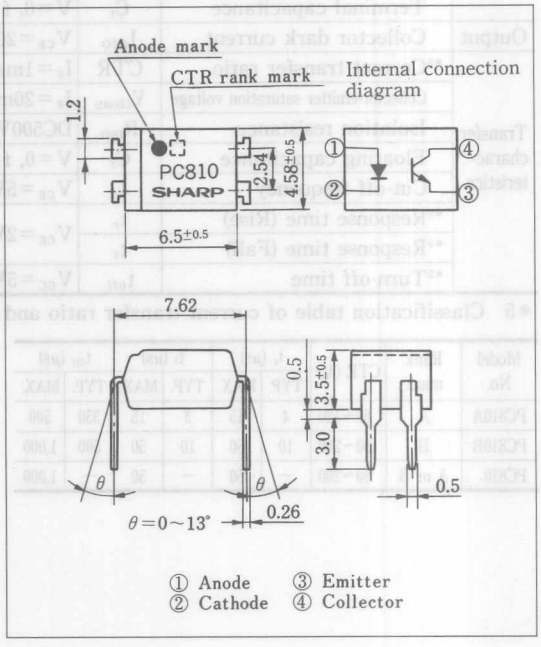
■ Features

1. High speed response under high load resistance
   (t_{off} : MAX. 1ms at I_F=1mA, V_{CC}=5V, R_L=110kΩ)
2. High current transfer ratio under low input current
   (CTR : MIN. 60% at I_F=1mA, V_{CE}=0.4V)
3. High isolation voltage between input and output
   (V_{iso} : 5,000Vrms)
4. Compact dual-in-line package
5. UL recognized, file No. E64380

■ Applications

1. Solid state relays
2. Motor-control equipment
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
	Total power dissipation	P_{tot}	200	mW
	*2Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−30~+100	°C
	Storage temperature	T_{stg}	−55~+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	*5Current transfer ratio	CTR	I_F=1mA, V_{CE}=0.4V	60	—	200	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=1kΩ	6	60	—	kHz
	*5Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=1kΩ	—	10	50	μs
	*5Response time (Fall)	t_f		—	10	50	μs
	*5Turn-off time	t_{off}	V_{CC}=5V, I_F=1mA, R_L=110kΩ	—	0.5	1.0	ms

*5 Classification table of current transfer ratio and response time is shown below.

Model No.	Rank mark	CTR (%)	t_r (μs)		t_f (μs)		t_{off} (μs)	
			TYP.	MAX.	TYP.	MAX.	TYP.	MAX.
PC810A	A	60~120	4	15	3	15	350	500
PC810B	B	100~200	10	50	10	50	500	1,000
PC810	A or B	60~200	—	50	—	50	—	1,000

Fig. 1 Forward Current vs. Ambient Temperatur

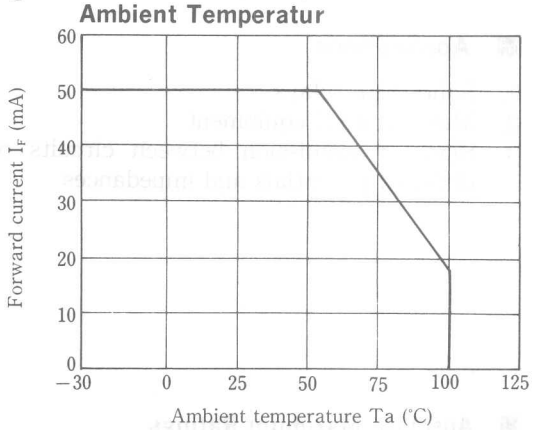


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

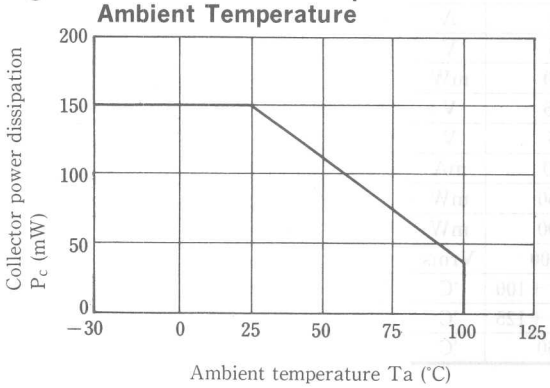


Fig. 3 Peak Forward Current vs. Duty Ratio

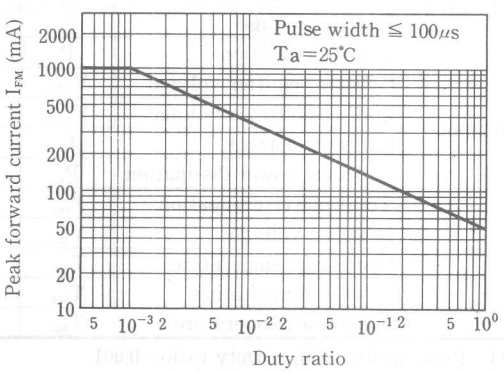


Fig. 4 Forward Current vs. Forward Voltage

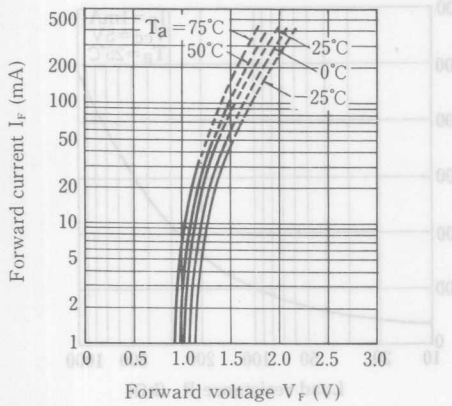


Fig. 5 Current Transfer Ratio vs. Forward Current

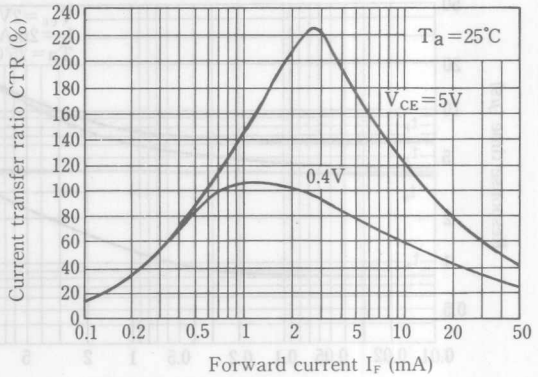


Fig. 6 Collector Current vs. Collector-emitter Voltage

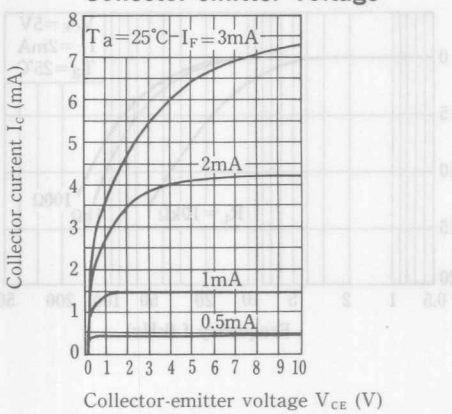


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

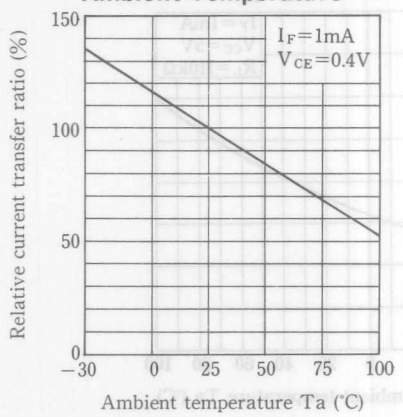


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

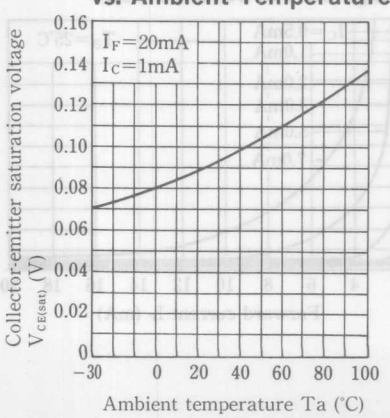
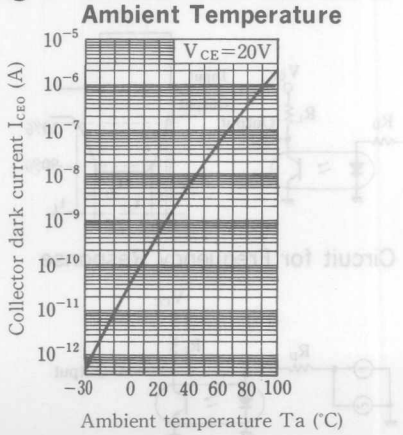


Fig. 9 Collector Dark Current vs. Ambient Temperature



6

Fig. 10 Response Time vs. Load Resistance

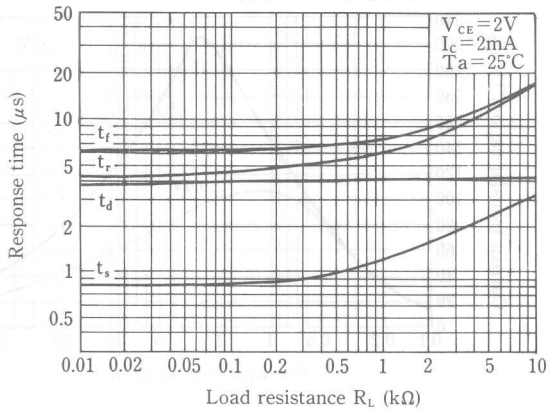


Fig. 11 Turn-off Time vs. Load Resistance

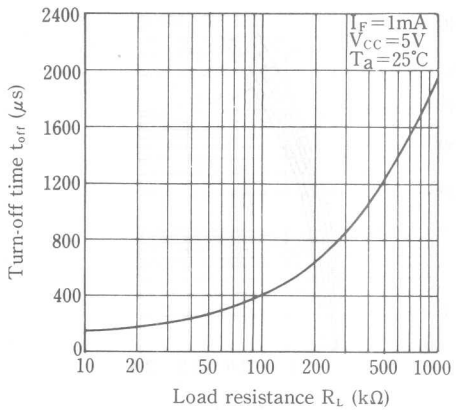


Fig. 12 Turn-off Time vs. Ambient Temperature

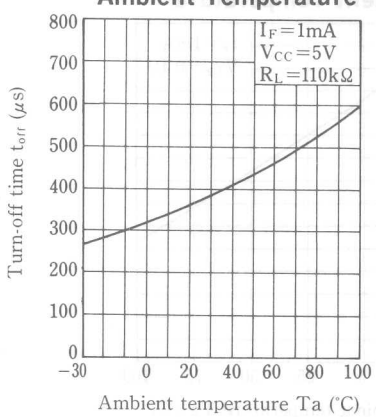
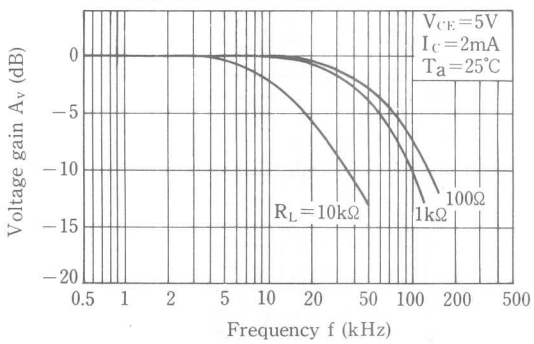
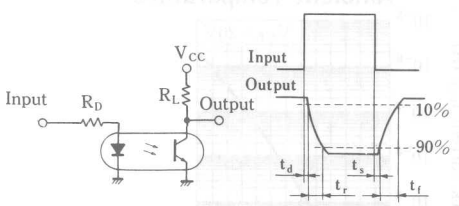


Fig. 13 Frequency Response



Test Circuit for Response Time



Test Circuit for Frequency Response

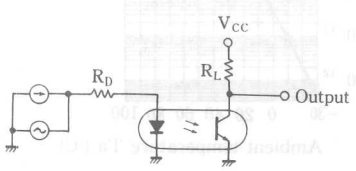
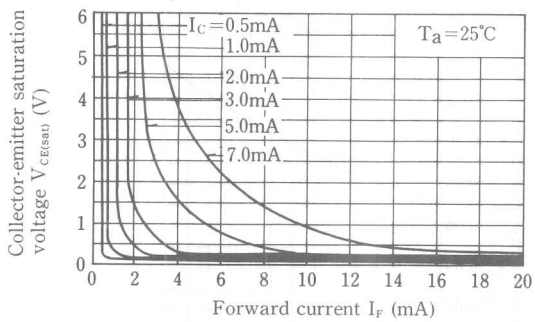


Fig. 14 Collector-emitter Saturation Voltage vs. Forward Current



PC812 High Noise Reduction Type Photocoupler

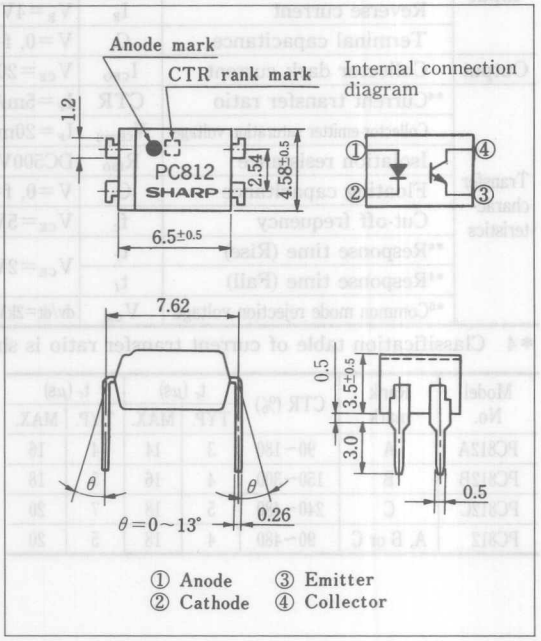
■ Features

1. High noise reduction
   (Common mode rejection voltage
   V_{CM} : TYP. 1.5kV at dv/dt=2kV/μs,
   R_L=470Ω, V_{np}=100mV)
2. High current transfer ratio
   (CTR : MIN. 90% at I_F=5mA, V_{CE}=5V)
3. High isolation voltage between input and output (V_{iso} : 5,000Vrms)
4. Compact dual-in-line package

■ Applications

1. Motor-control circuits
2. Computer terminals
3. System appliances, measuring instruments
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30~+100	°C
Storage temperature		T_{stg}	−55~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

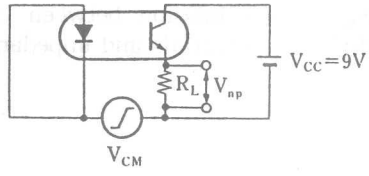
(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	*4Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	90	—	480	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω	15	80	—	kHz
	*4Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	4	18	μs
	*4Response time (Fall)	t_f		—	5	20	μs
	*5Common mode rejection voltage	V_{CM}	dv/dt=2kV/μs, R_L=470Ω, V_{np}=100mV, I_F=0	—	1.5	—	kV

*4 Classification table of current transfer ratio is shown below.

Model No.	Rank mark	CTR (%)	t_r (μs)		t_f (μs)	
			TYP.	MAX.	TYP.	MAX.
PC812A	A	90~180	3	14	4	16
PC812B	B	150~300	4	16	5	18
PC812C	C	240~480	5	18	7	20
PC812	A, B or C	90~480	4	18	5	20

* 5 Test Circuit for V_{CM}



V_{CM} : Common mode rejection Voltage (higher value of pulse wave)
dv/dt : Rising factor of voltage

Test condition
V_{np}=100mV, R_L=470Ω
dv/dt=2kV/μs, I_F=0

Fig. 1 Forward Current vs. Ambient Temperature

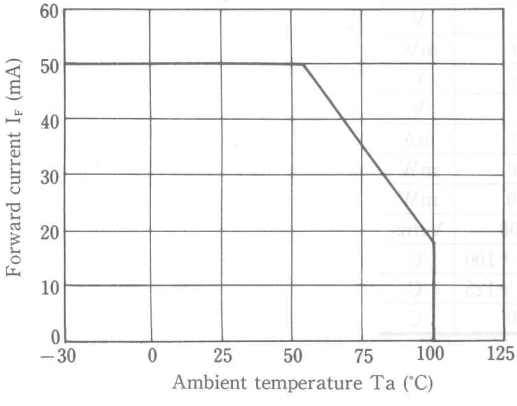


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

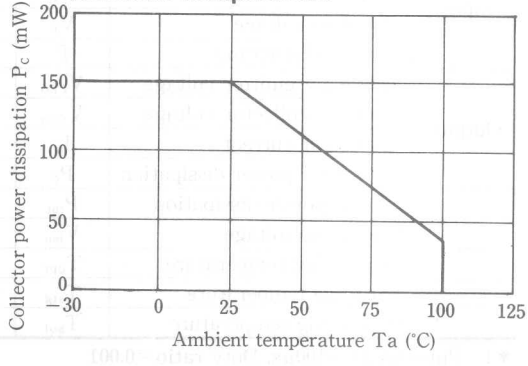


Fig. 3 Peak Forward Current vs. Duty Ratio

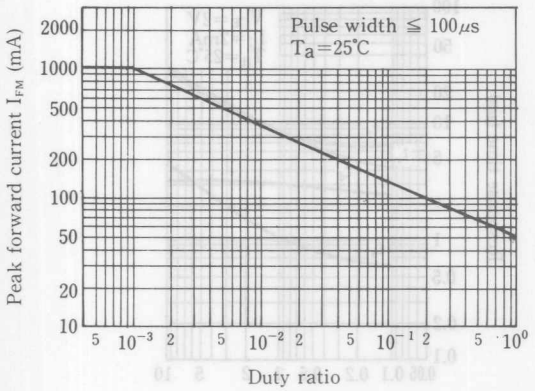


Fig. 4 Forward Current vs. Forward Voltage

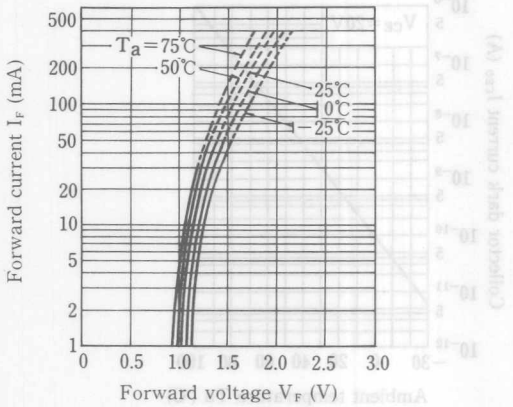


Fig. 5 Current Transfer Ratio vs. Forward Current

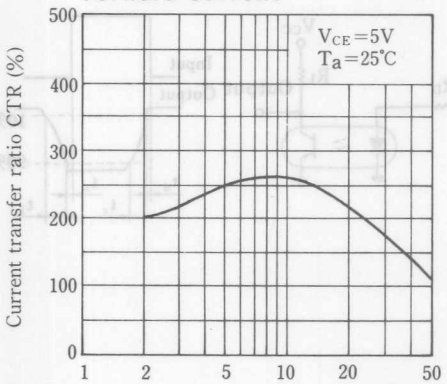


Fig. 6 Collector Current vs. Collector-emitter Voltage

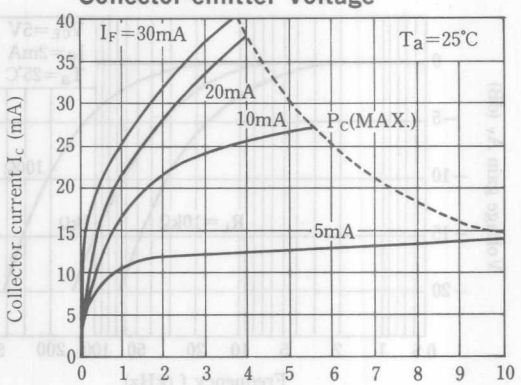


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

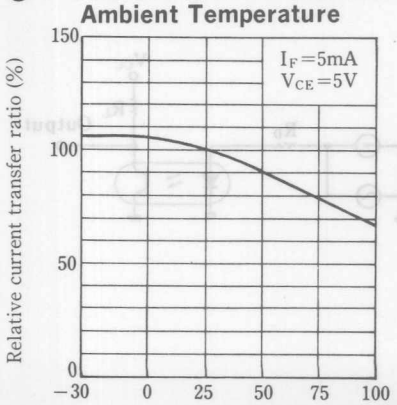
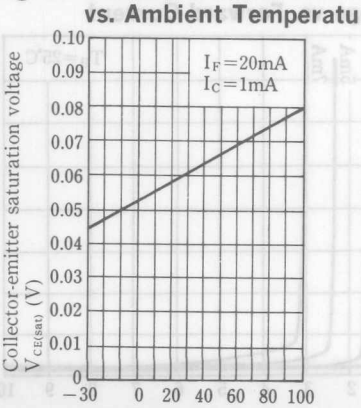


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature



6

Fig. 9 Collector Dark Current vs. Ambient Temperature

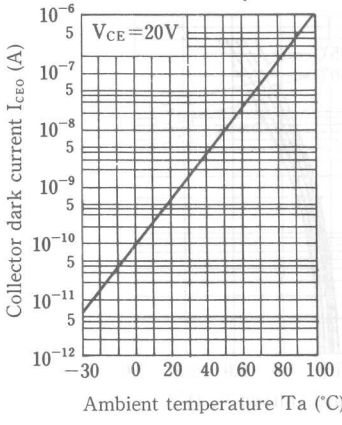


Fig. 10 Response Time vs. Load Resistance

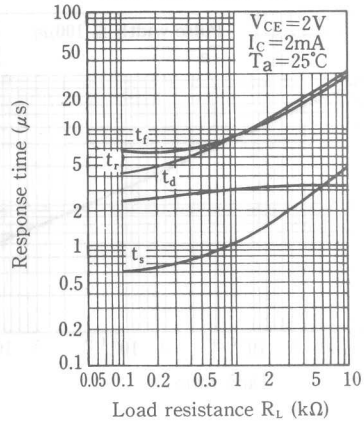
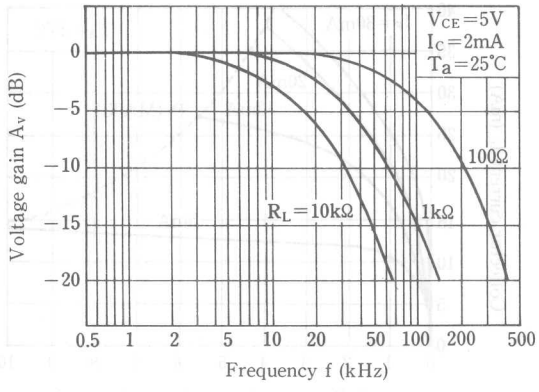


Fig. 11 Frequency Response



Test Circuit for Response Time

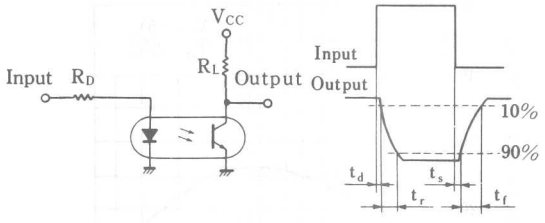
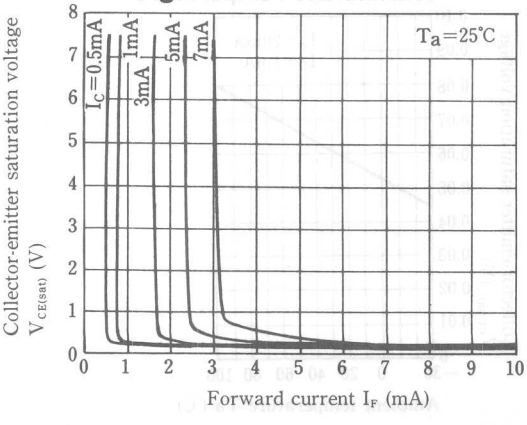
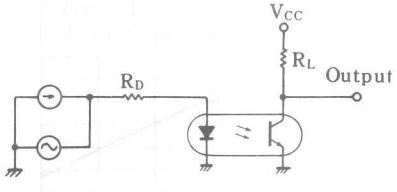


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



PC813 Series

AC Input Response & High Noise Reduction Type Photocoupler

■ Features

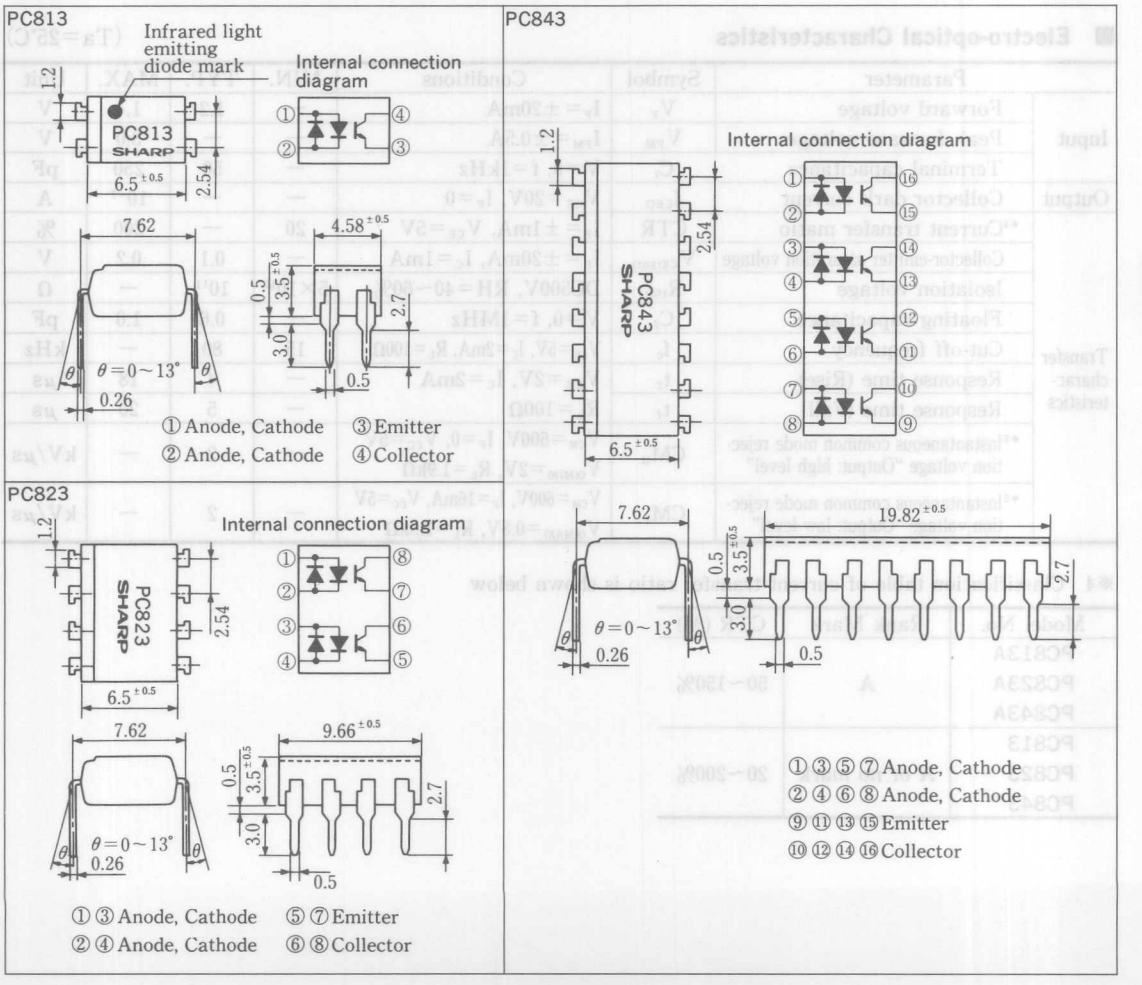
1. High instantaneous common mode rejection voltage (CM_H: TYP. 2kV/μs)
2. AC input response
3. Compact dual-in-line package
   PC813 (1ch), PC823 (2ch), PC843 (4ch)
4. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
5. UL recognized, file No. E64380

■ Applications

1. Telephones (PC813)
2. Programmable controllers (PC823/PC843)
3. System appliances, measuring instruments
4. Signal transmission between circuits of different pontetials and impedances

■ Outline Dimensions

(Unit : mm)



6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	±50	mA
	*1Peak forward current	I_{FM}	±1	A
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30～+100	°C
Storage temperature		T_{stg}	−55～+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

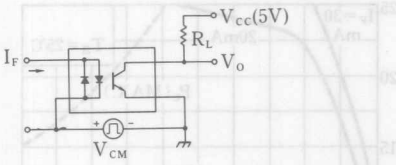
■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=±20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=±0.5A	—	—	3.0	V
	Terminal capacitance	C_t	V=0, f=1kHz	—	50	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	*4Current transfer matio	CTR	I_F=±1mA, V_{CE}=5V	20	—	200	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=±20mA, I_C=1mA	—	0.1	0.2	V
	Isolation voltage	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω	15	80	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	4	18	μs
	Response time (Fall)	t_f	R_L=100Ω	—	5	20	μs
	*5Instantaneous common mode rejection voltage "Output: high level"	CM_H	V_{CM}=600V, I_F=0, V_{CC}=5V, $V_{O(MIN)}$=2V, R_L=1.9kΩ	—	2	—	kV/μs
	*5Instantaneous common mode rejection voltage "Output: low level"	CM_L	V_{CM}=600V, I_F=16mA, V_{CC}=5V, $V_{O(MAX)}$=0.8V, R_L=1.9kΩ	—	2	—	kV/μs

※4 Classification table of current transfer ratio is shown below

Model No.	Rank Mark	CTR (%)
PC813A PC823A PC843A	A	50～150%
PC813 PC823 PC843	A or no mark	20～200%

*5 Test Circuit for instantaneous common mode rejection voltage



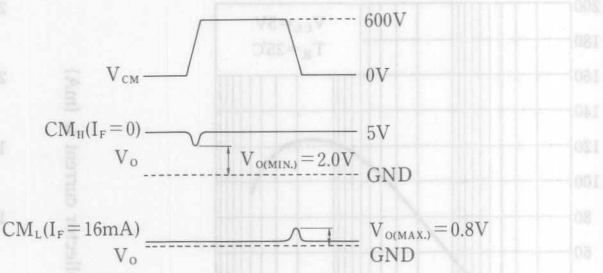


Fig. 1 Forward Current vs. Ambient Temperature

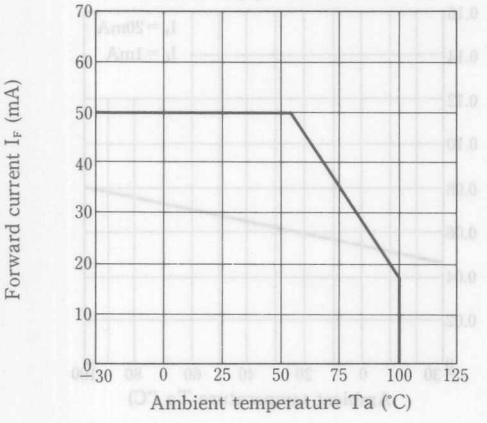


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

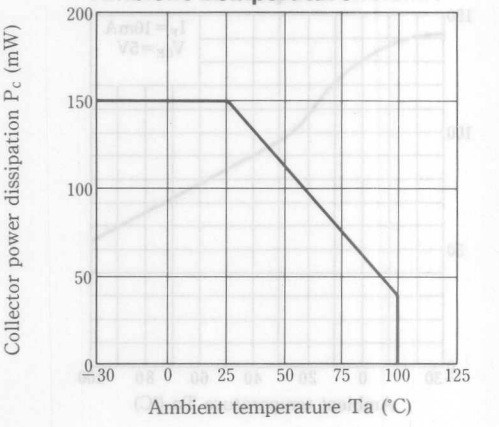


Fig. 3 Feak Forward Current vs. Duty Ratio

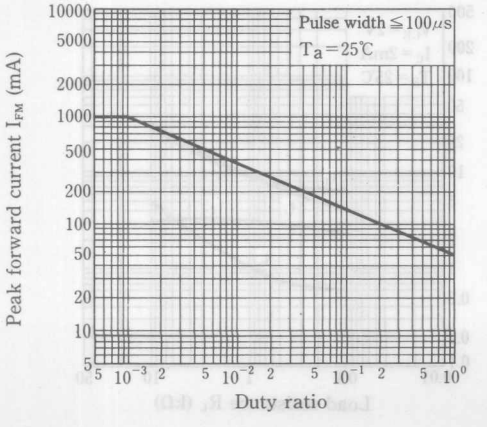
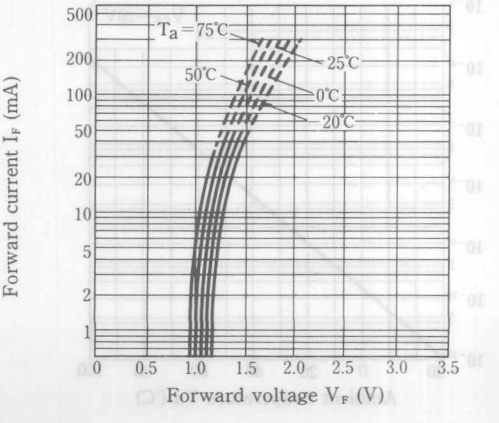


Fig. 4 Forward Current vs. Forward Voltage



6

Fig. 5 Current Transfer Ratio vs. Forward Current

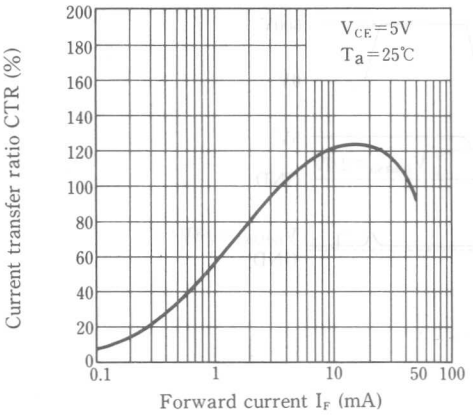


Fig. 6 Collector Current vs. Collector-emitter voltage

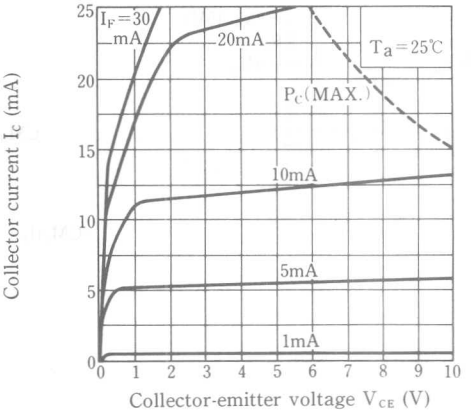


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

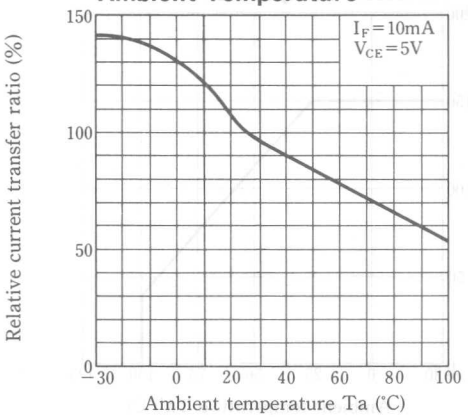


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

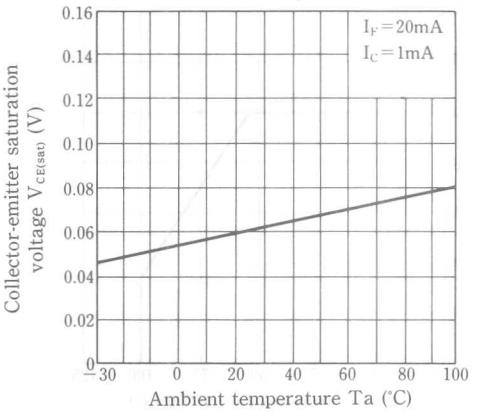


Fig. 9 Collector Dark Current vs. Ambient Temperature

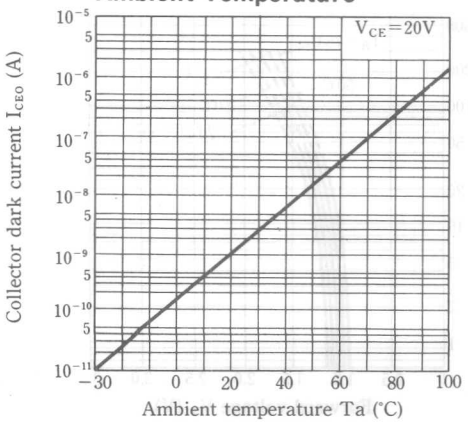


Fig. 10 Response Time vs. Load Resistance

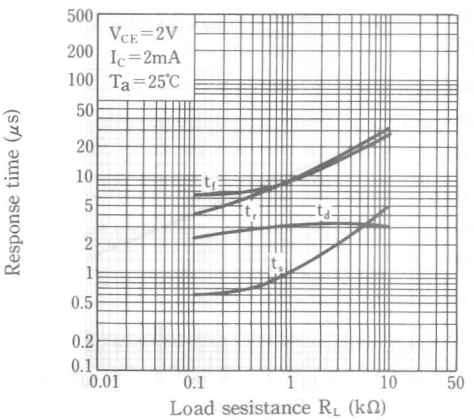
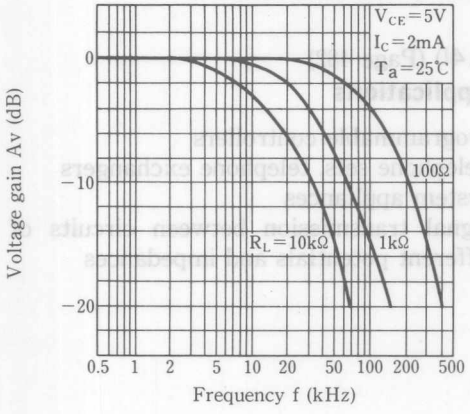


Fig. 11 Frequency Response



Test Circuit for Response Time

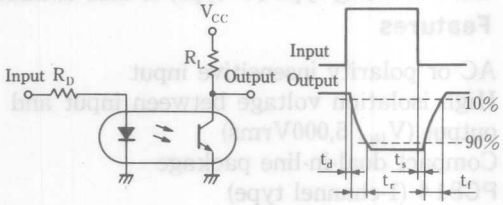
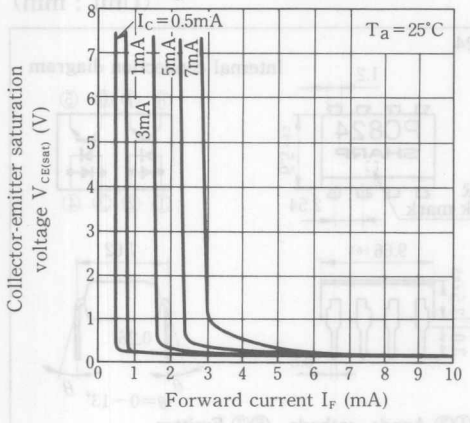
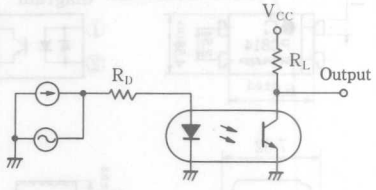


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



6

PC814 Series AC Input Type Photocoupler

※ Lead forming type (I type) is also available. (PC814I) (Page 482)

■ Features

1. AC or polarity insensitive input
2. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
3. Compact dual-in-line package
   PC814 (1-channel type)
   PC824 (2-channel type)
   PC844 (4-channel type)
4. Current transfer ratio
   CTR: MIN. 20% at $I_F = \pm 1$mA, $V_{CE} = 5$V
5. UL recognized, file No. E64380

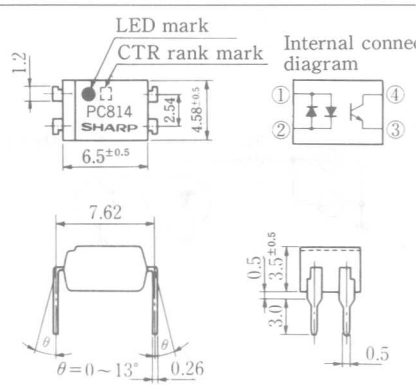
■ Applications

1. Programmable controllers
2. Telephone sets, telephone exchangers
3. System appliances
4. Signal transmission between circuits of different potentials and impedances

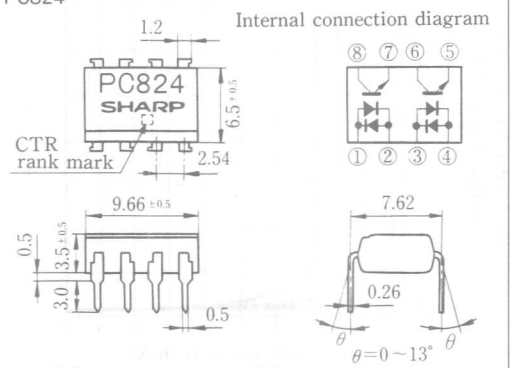
■ Outline Dimensions

(Unit : mm)

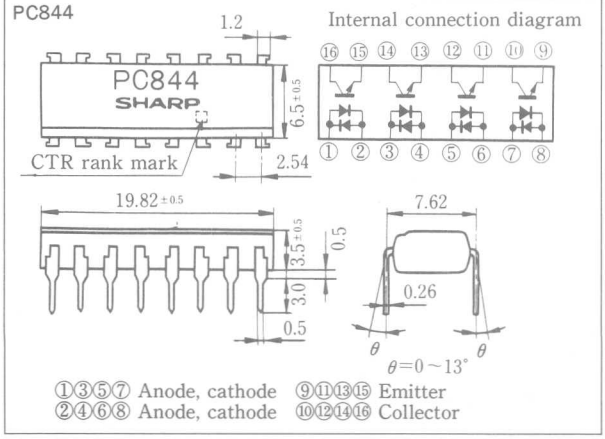
PC814



PC824



PC844



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	±50	mA
	*1Peak forward current	I_{FM}	±1	A
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30～+100	°C
Storage temperature		T_{stg}	−55～+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Inpuut	Forward voltage	V_F	I_F=±20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=±0.5A	—	—	3.0	V
	Terminal capacitance	C_t	V=0, f=1kHz	—	50	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	*4Current transfer ratio	CTR	I_F=±1mA, V_{CE}=5V	20	—	300	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=±20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω	15	80	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	4	18	μs
	Response time (Fall)	t_f		—	3	18	μs

*4 Classification table of current transfer ratio

Model No.	Rank mark	CTR (%)
PC814A PC824A PC844A	A	50～150
PC814 PC824 PC844	A or no mark	20～300

6

Fig. 1 Forward Current vs. Ambient Temperature

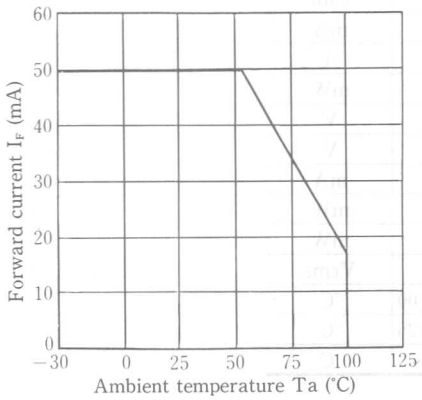


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

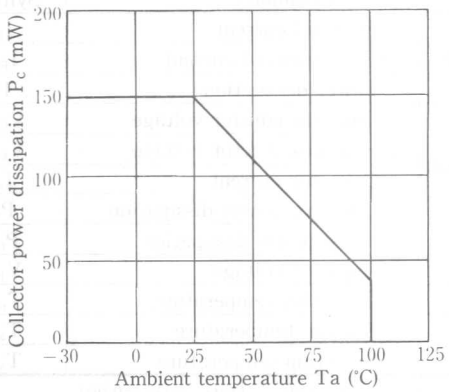


Fig. 3 Peak Forward Current vs. Duty Ratio

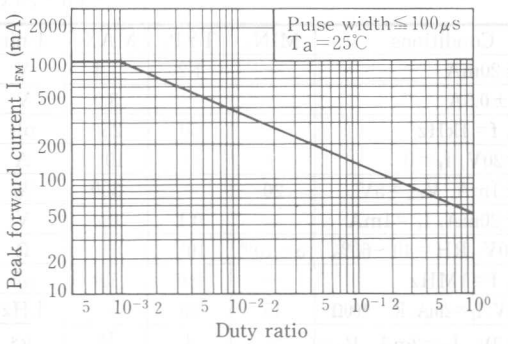


Fig. 4 Forward Current vs. Forward Voltage

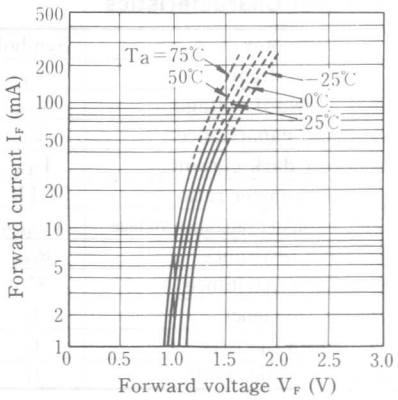


Fig. 5 Current Transfer Ratio vs. Forward Current

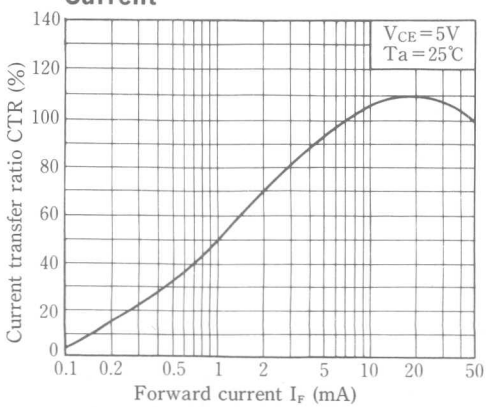


Fig. 6 Collector Current vs. Collector-emitter Voltage

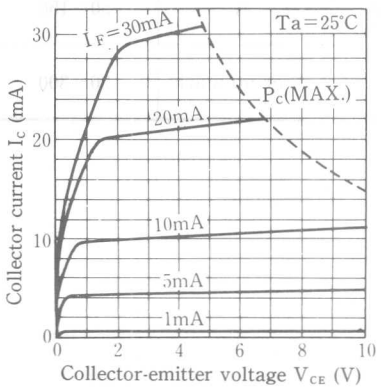


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

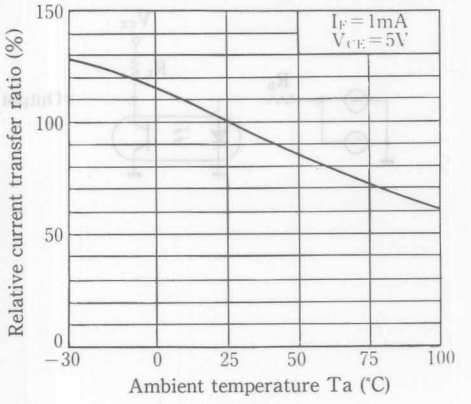


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

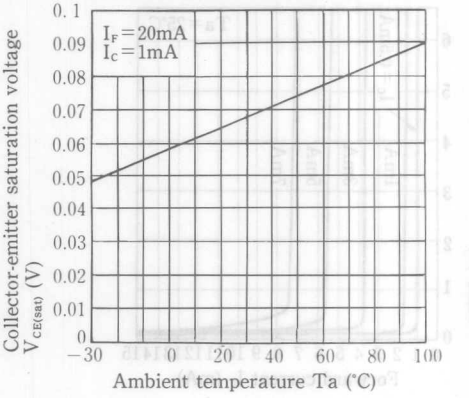


Fig. 9 Collector Dark Current vs. Ambient Temperature

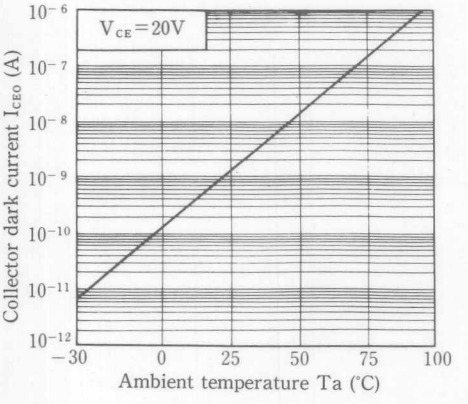


Fig. 10 Response Time vs. Load Resistance

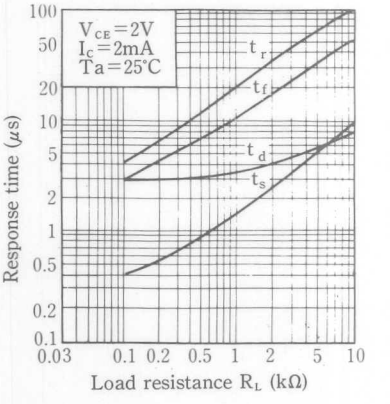
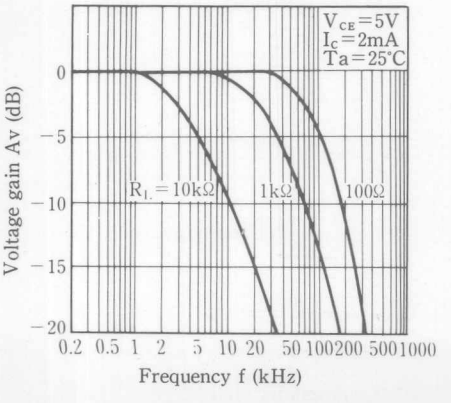
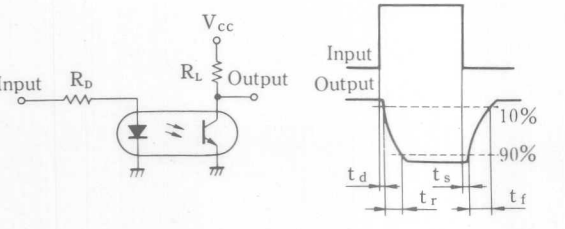


Fig. 11 Frequency Response

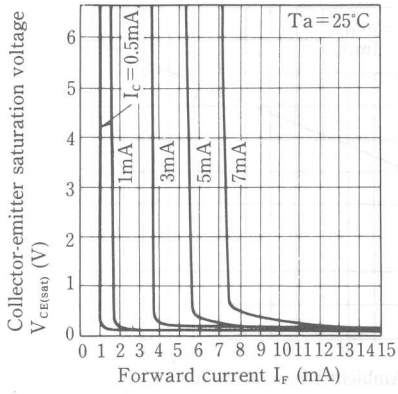


Test Circuit for Response Time

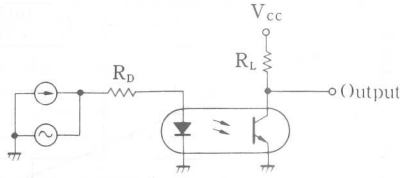


6

Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



PC815 Series

High Sensitivity, High Density Mounting Type Photocoupler

※ Lead forming type (I type) is also available. (PC815I) (Page 482)

■ Features

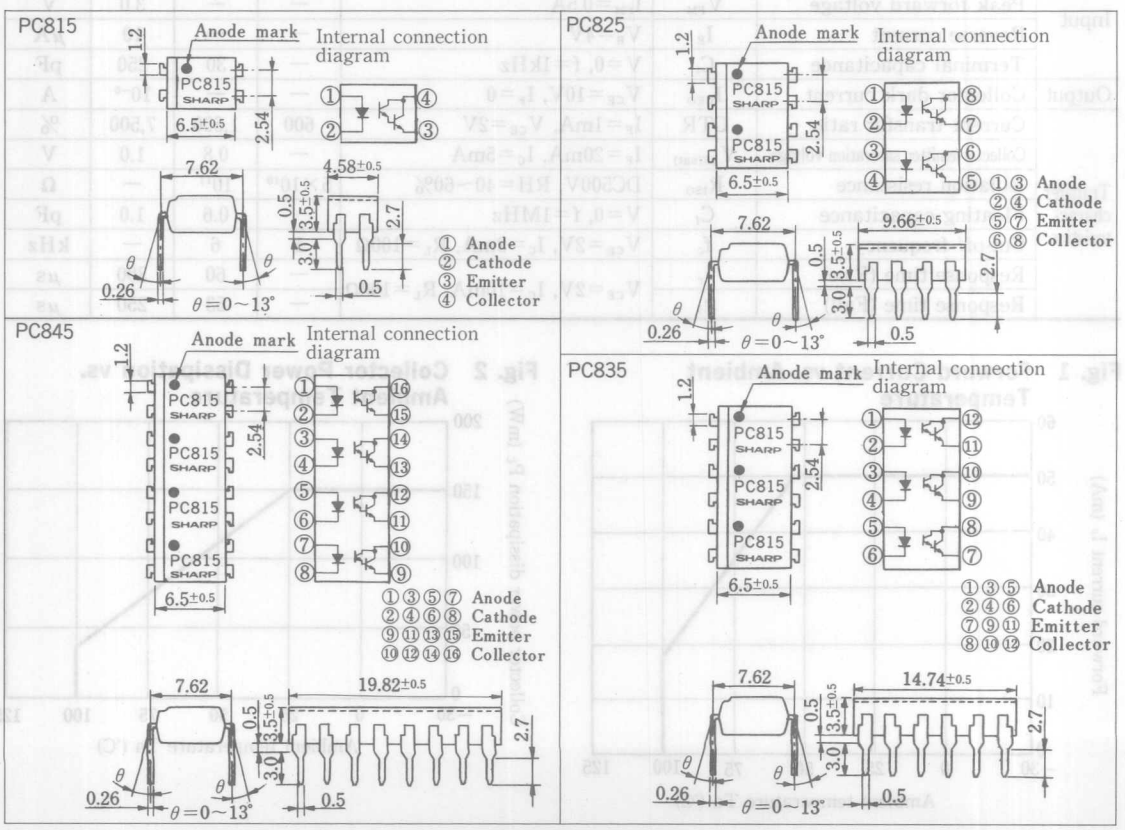
1. High current transfer ratio
   (CTR : MIN. 600% at I_F=1mA, V_{CE}=2V)
2. High isolation voltage between input and output
   (V_{ISO} : 5,000Vrms)
3. Compact dual-in-line package
   PC815 : 1-channel type
   PC825 : 2-channel type
   PC835 : 3-channel type
   PC845 : 4-channel type
4. UL recognized, file No. E64380
   TÜV approved No. R40001

■ Applications

1. System appliances, measuring instruments
2. Industrial robots
3. Copiers, automatic vending machines
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions

(Unit : mm)



6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	80	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30～+100	°C
Storage temperature		T_{stg}	−55～+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=10V, I_F=0	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	600	1,600	7,500	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=5mA	—	0.8	1.0	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=2V, I_C=2mA, R_L=100Ω	1	6	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=10mA, R_L=100Ω	—	60	300	μs
	Response time (Fall)	t_f		—	53	250	μs

Fig. 1 Forward Current vs. Ambient Temperature

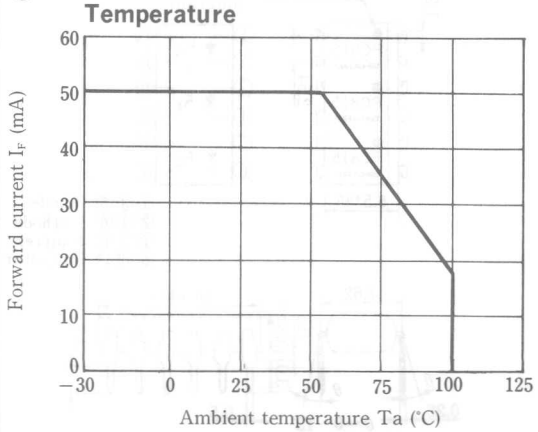


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

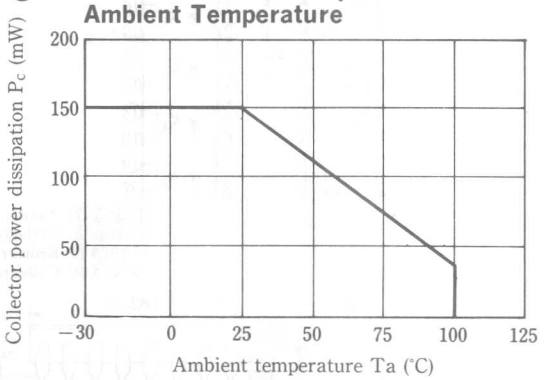


Fig. 3 Peak Forward Current vs. Duty Ratio

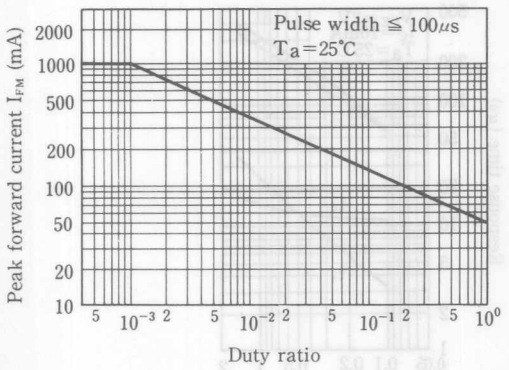


Fig. 4 Forward Current vs. Forward Voltage

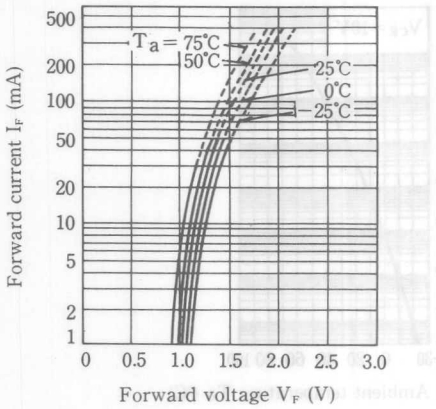


Fig. 5 Current Transfer Ratio vs. Forward Current

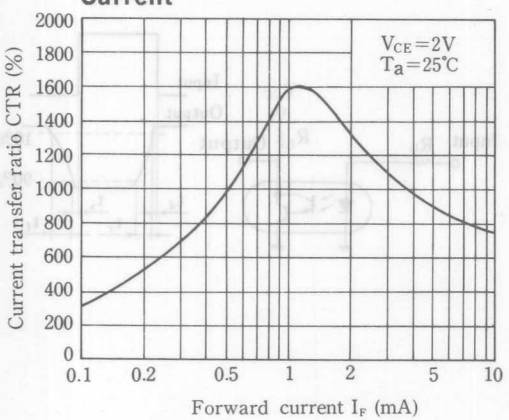


Fig. 6 Collector Current vs. Collector-emitter Voltage

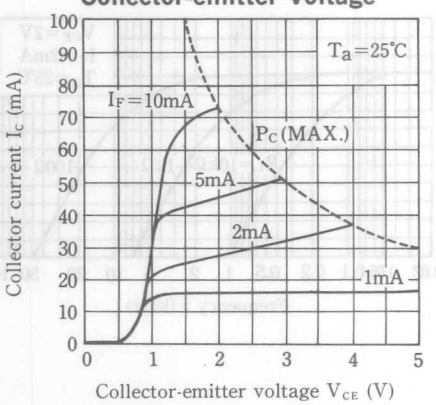


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

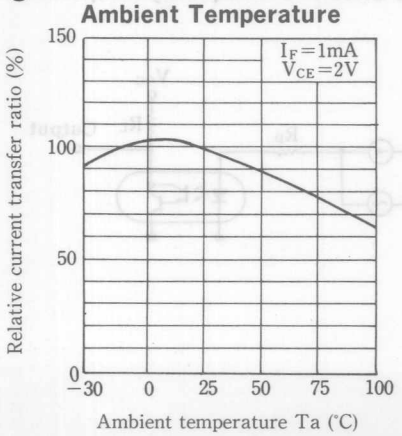
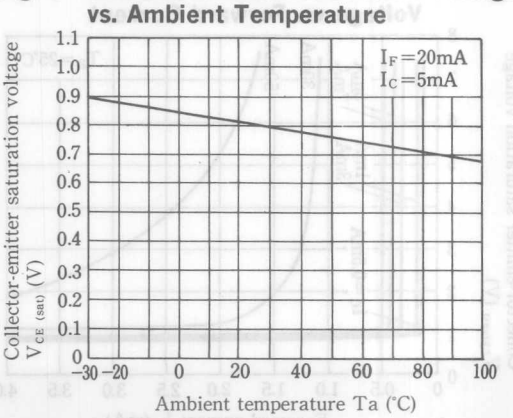


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature



6

Fig. 9 Collector Dark Current vs. Ambient Temperature

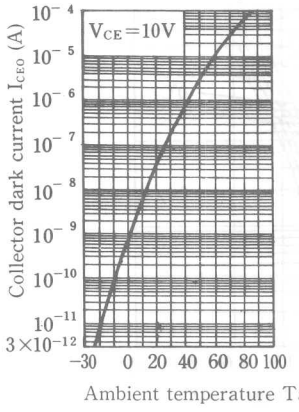


Fig. 10 Response Time vs. Load Resistance

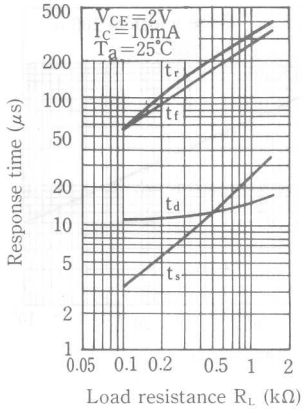
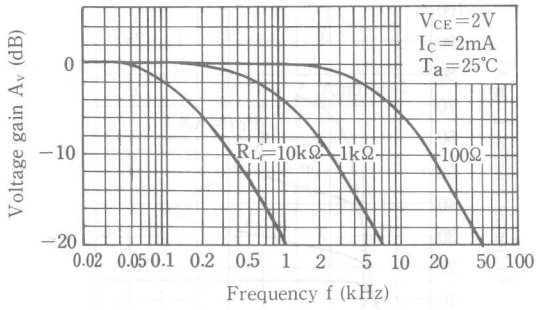


Fig. 11 Frequency Response



Test Circuit for Response Time

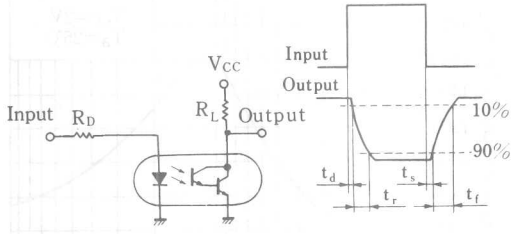
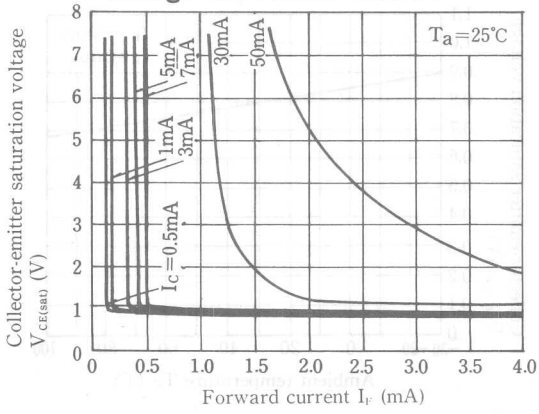
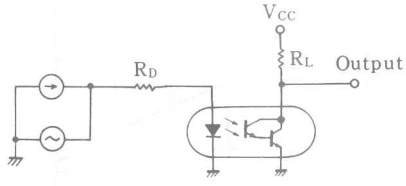


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



PC816 Series

High Collector-emitter Voltage, High Density Mounting Type Photocoupler

■ Features

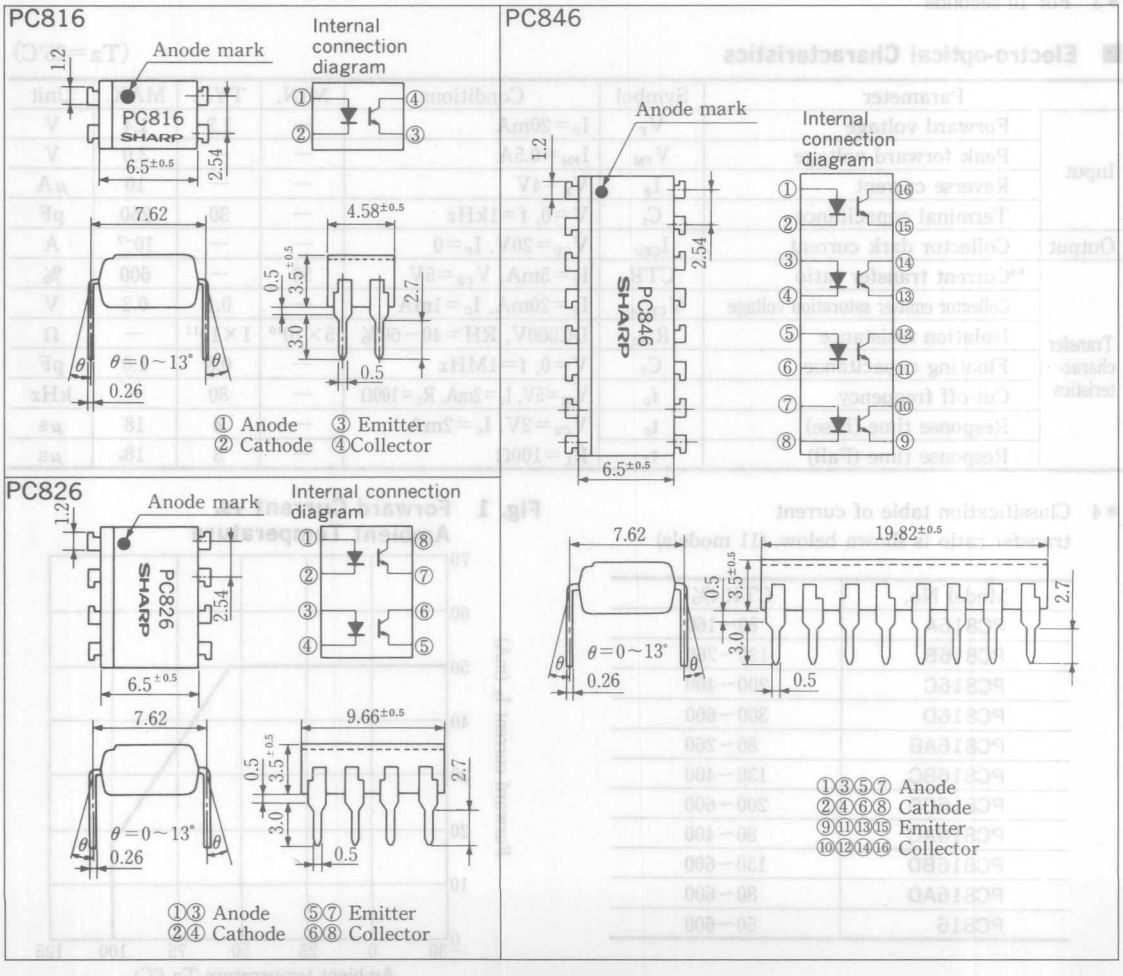
1. High collector-emitter voltage (V_{CEO}: 70V)
2. Compact dual-in-line package
   PC816: 1-channel type
   PC826: 2-channel type
   PC846: 4-channel type
3. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
4. Current transfer ratio
   CTR: MIN. 50% at I_F=5mA, V_{CE}=5V
5. UL recognized, file No. E64380

■ Applications

1. Programmable controllers, Computers
2. System appliances, measuring instruments
3. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions

(Unit : mm)



6

■ Absolute Maximum Ratings

(Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	70	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30～+100	°C
Storage temperature		T_{stg}	−55～+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	—	10^{-7}	A
Transfer characteristics	*4Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	50	—	600	%
	Collector emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	1×10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω	—	80	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	4	18	μs
	Response time (Fall)	t_f	R_L=100Ω	—	3	18	μs

*4 Classification table of current transfer ratio is shown below. (11 models)

Model No.	CTR (%)
PC816A	80～160
PC816B	130～260
PC816C	200～400
PC816D	300～600
PC816AB	80～260
PC816BC	130～400
PC816CD	200～600
PC816AC	80～400
PC816BD	130～600
PC816AD	80～600
PC816	50～600

Fig. 1 Forward Current vs. Ambient Temperature

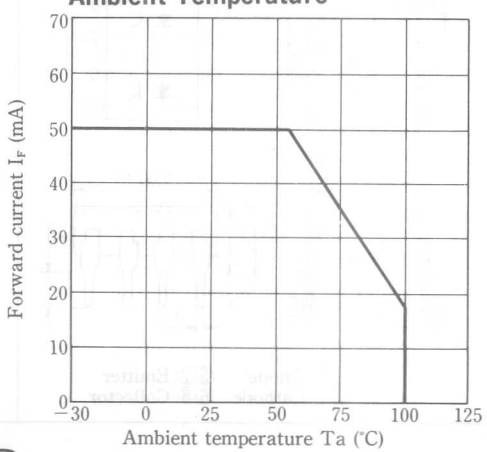


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

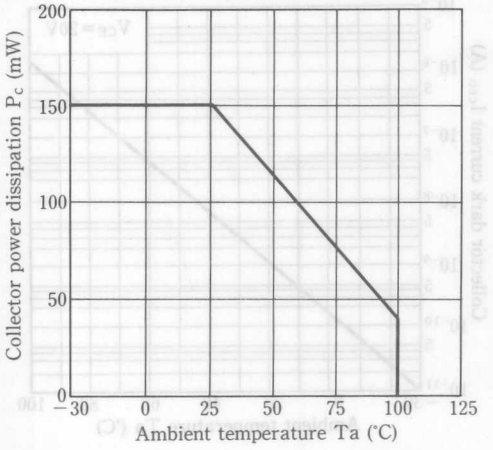


Fig. 3 Peak Forward Current vs. Duty Ratio

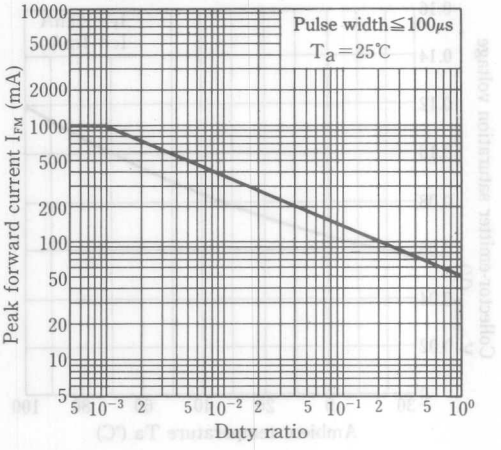


Fig. 4 Forward Current vs. Forward Voltage

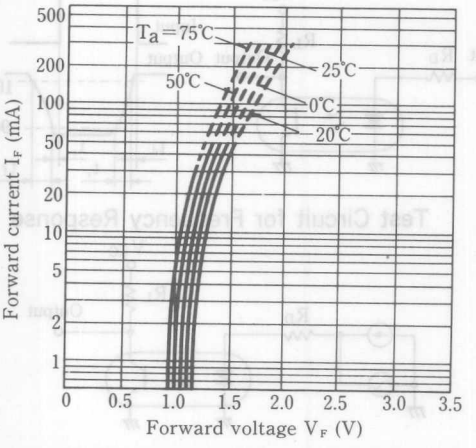


Fig. 5 Current Transfer Ratio vs. Forward Current

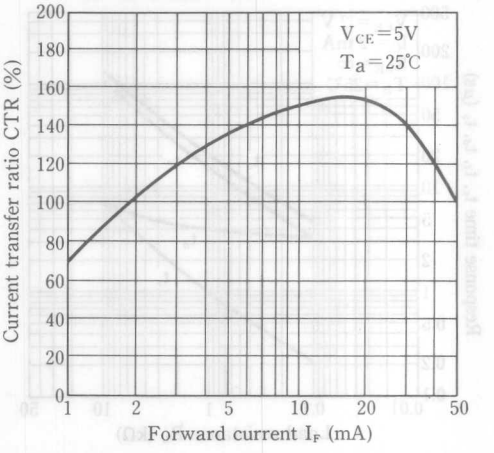


Fig. 6 Collector Current vs. Collector-emitter Voltage

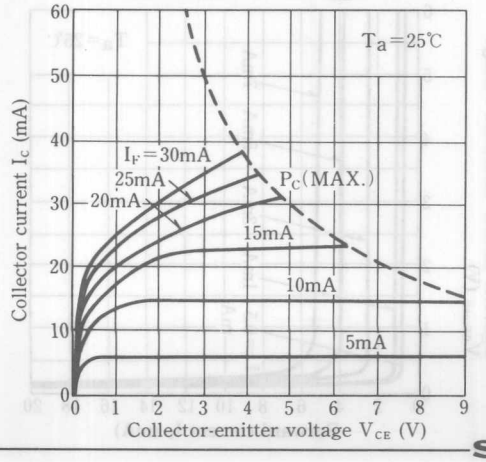
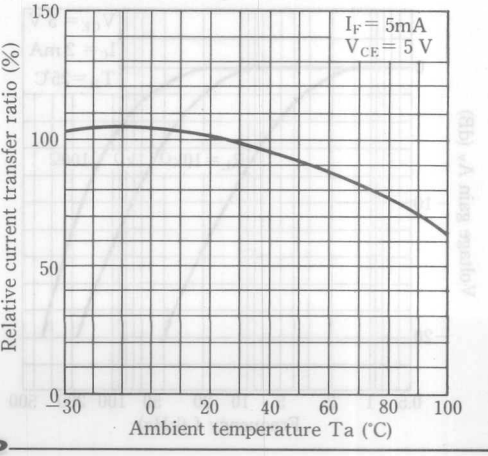


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature



6

Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

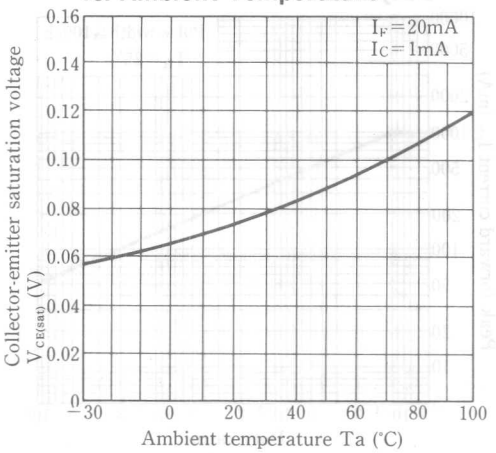


Fig. 9 Collector Dark Current vs. Ambient Temperature

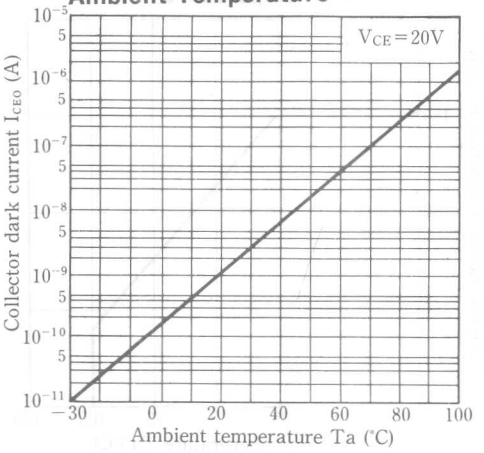
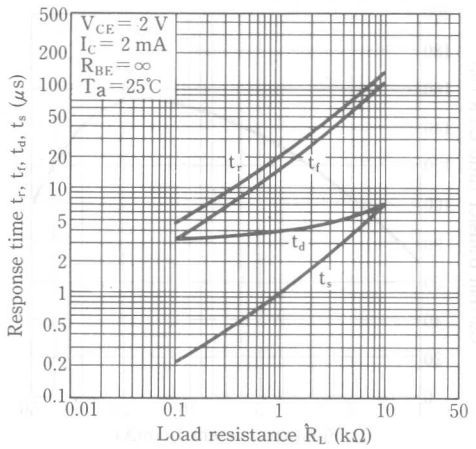
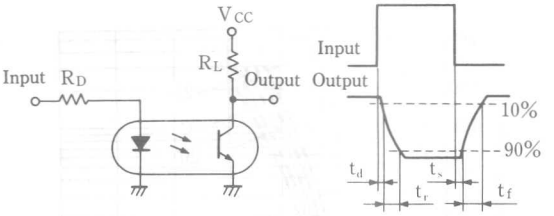


Fig. 10 Response Time vs. Load Resistance



Test Circuit for Response Time



Test Circuit for Frequency Response

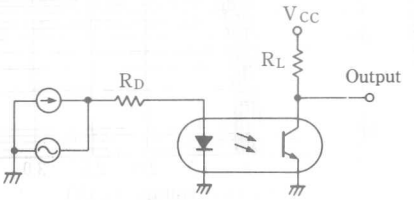


Fig. 11 Frequency Response

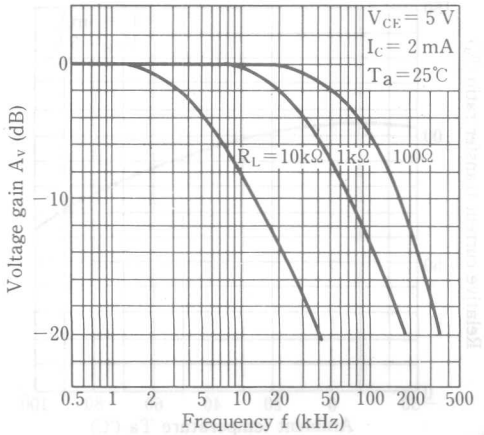
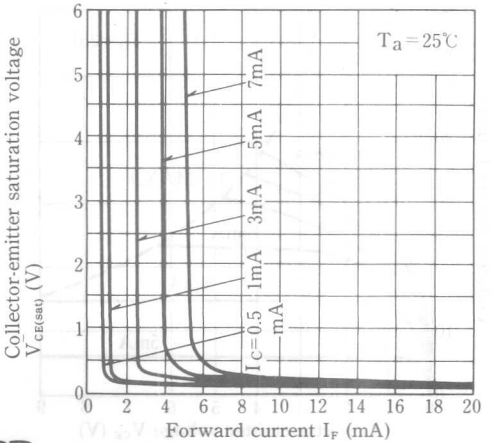


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



PC817 Series High Density Mounting Type Photocoupler

※ Lead forming type (I type) is also available. (PC817I) (Page 482)

■ Features

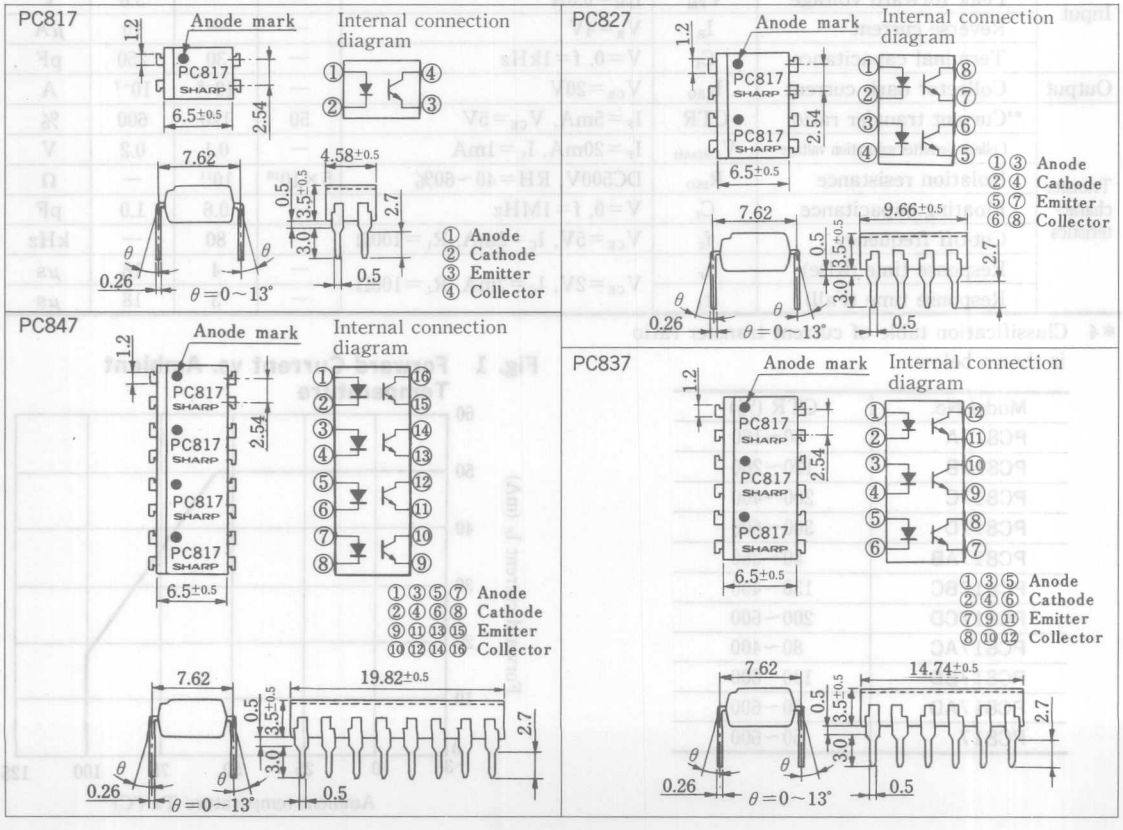
1. Current transfer ratio
   CTR : MIN. 50% at I_F=5mA, V_{CE}=5V
2. High isolation voltage between input and output (V_{iso} : 5,000Vrms)
3. Compact dual-in-line package
   PC817 : 1-channel type
   PC827 : 2-channel type
   PC837 : 3-channel type
   PC847 : 4-channel type
4. UL recognized, file No. E64380
   TÜV approved, No. R20042

■ Applications

1. Computer terminals
2. System appliances, measuring instruments
3. Registers, copiers, automatic vending machines
4. Electric home appliances, such as fan heaters, etc.
5. Medical instruments, physical and chemical equipment
6. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions

(Unit : mm)



6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30～+100	°C
Storage temperature		T_{stg}	−55～+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	*4Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	50	120	600	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω	—	80	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	4	18	μs
	Response time (Fall)	t_f		—	3	18	μs

*4 Classification table of current transfer ratio is shown below.

Model No.	CTR (%)
PC817A	80～160
PC817B	130～260
PC817C	200～400
PC817D	300～600
PC817AB	80～260
PC817BC	130～400
PC817CD	200～600
PC817AC	80～400
PC817BD	130～600
PC817AD	80～600
PC817	50～600

Fig. 1 Forward Current vs. Ambient Temperature

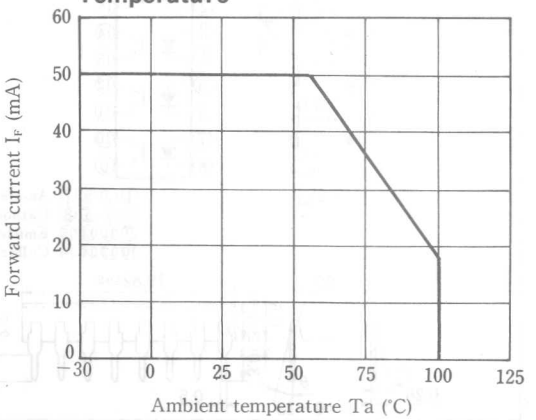


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

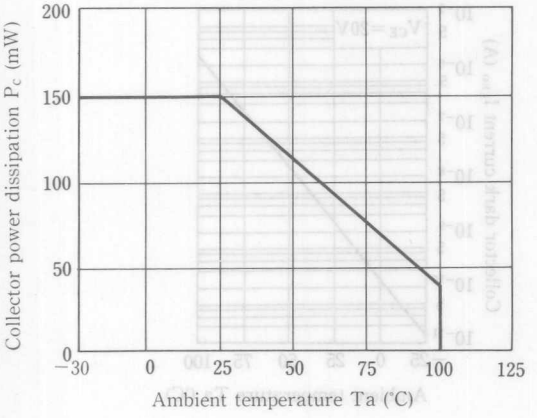


Fig. 3 Peak Forward Current vs. Duty Ratio

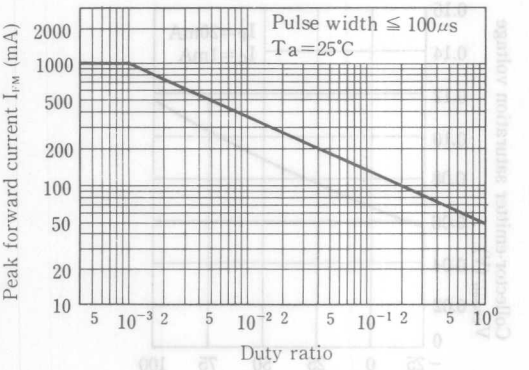


Fig. 4 Current Transfer Ratio vs. Forward Current

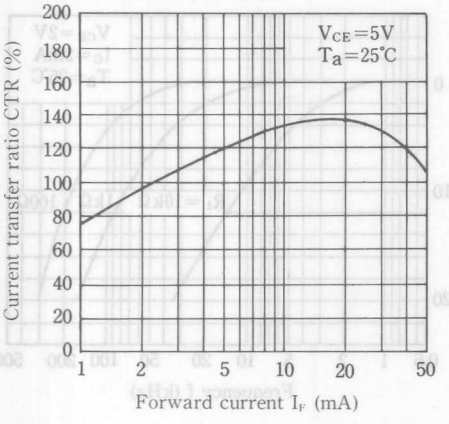


Fig. 5 Forward Current vs. Forward Voltage

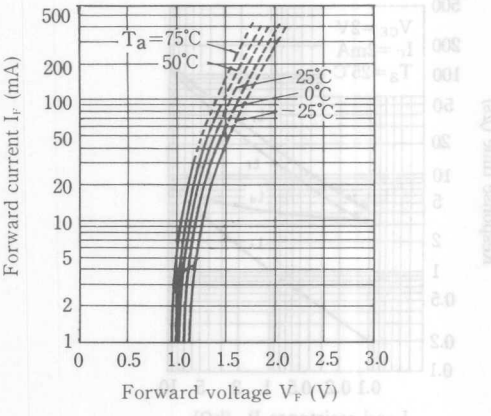


Fig. 6 Collector Current vs. Collector-emitter Voltage

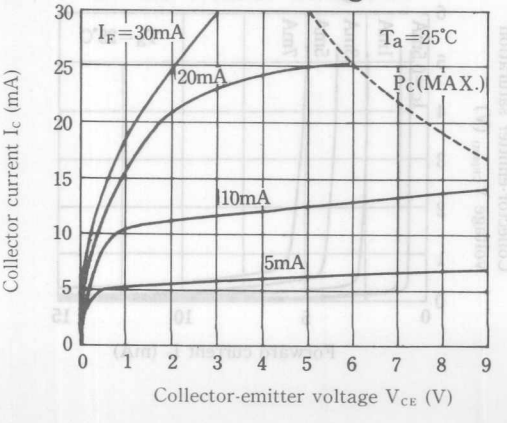
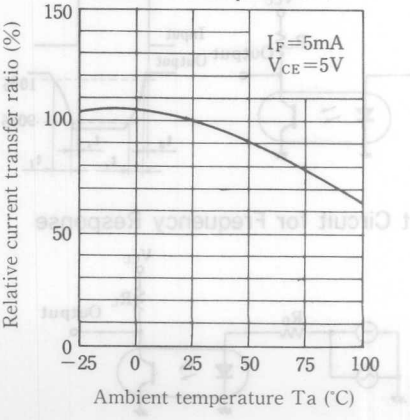


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature



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Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

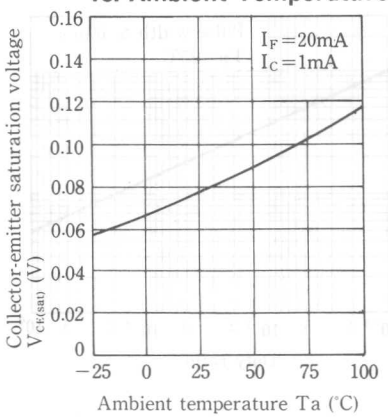


Fig. 9 Collector Dark Current vs. Ambient Temperature

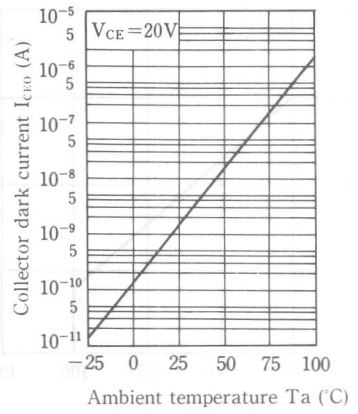


Fig. 10 Response Time vs. Load Resistance

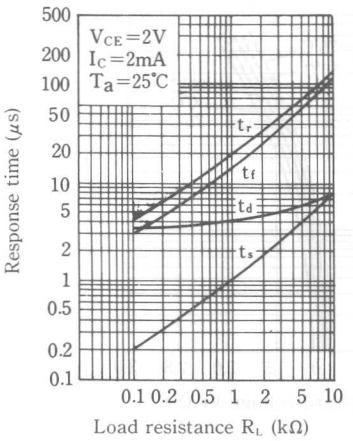
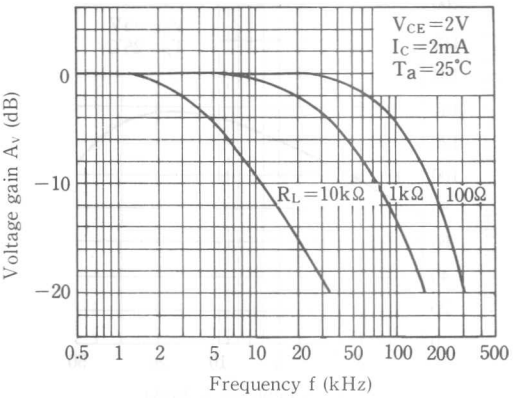
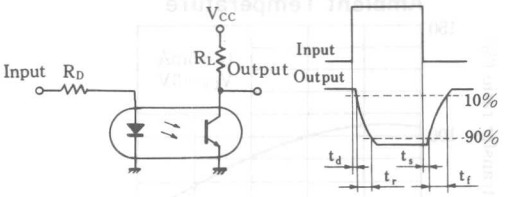


Fig. 11 Frequency Response



Test Circuit for Response Time



Test Circuit for Frequency Response

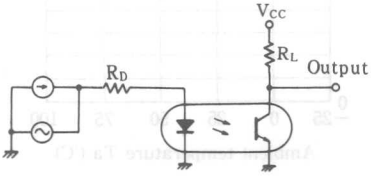
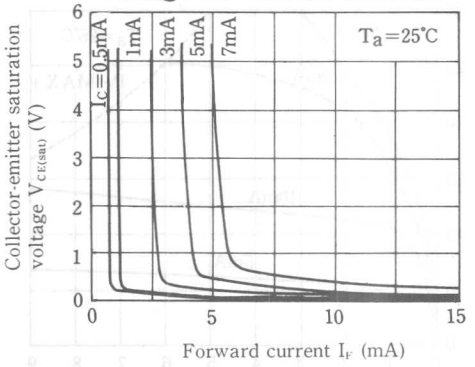


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



PC818 High Density Mounting Type Photocoupler

※Lead forming type (I type) is also available. (PC818I) (Page 482)

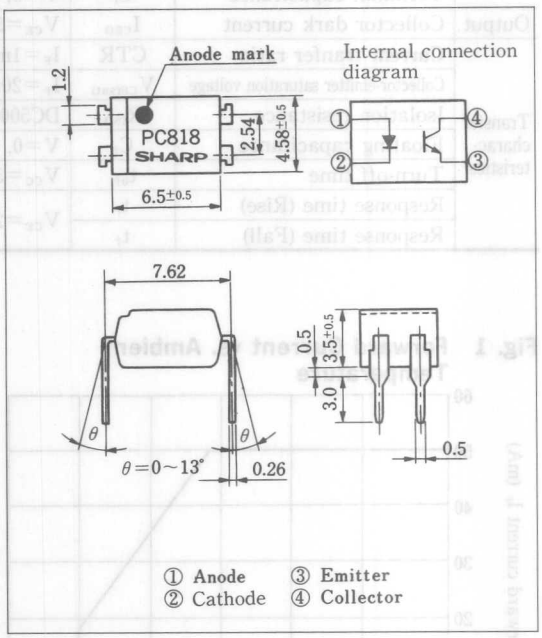
■ Features

1. High isolation voltage between input and output (V_{iso} : 5,000Vrms)
2. Low collector dark current (I_{CEO} : MAX. 6×10^{-9}A at V_{CE}=5V)
3. Current transfer ratio CTR : MIN. 10% at I_F=1mA, V_{CE}=0.4V
4. Compact dual-in-line package
5. UL recognized, file No. E64380 TÜV approved, No. R40002

■ Applications

1. Computer peripherals
2. System appliances, measuring instruments
3. Copiers, automatic vending machines, medical instruments
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	200	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30~+100	°C
Storage temperature		T_{stg}	−55~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=5V, I_F=0	—	—	6×10^{-9}	A
Transfer characteristics	Current tranfer ratio	CTR	I_F=1mA, V_{CE}=0.4V	10	30	100	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.2	0.4	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Turn-off time	t_{off}	V_{CC}=5V, I_F=1mA, R_L=110kΩ	—	—	650	μs
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=1kΩ	—	7	40	μs
	Response time (Fall)	t_f		—	6	40	μs

Fig. 1 Forward Current vs. Ambient Temperature

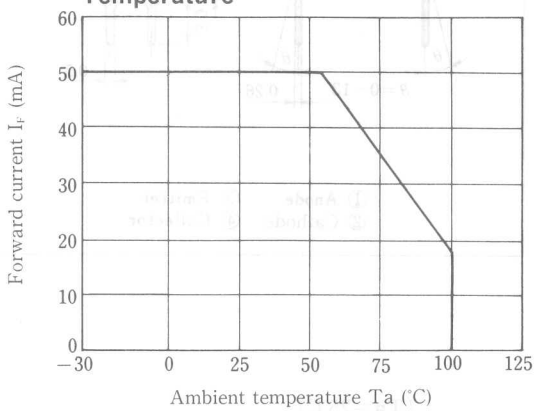


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

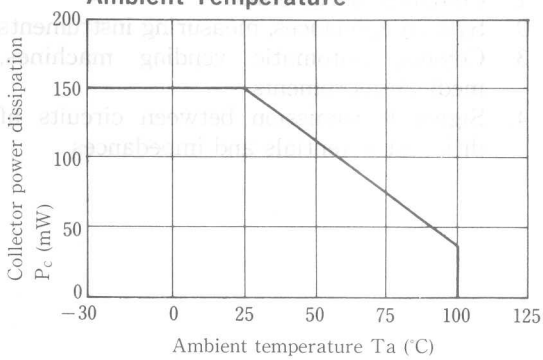


Fig. 3 Peak Forward Current vs. Duty Ratio

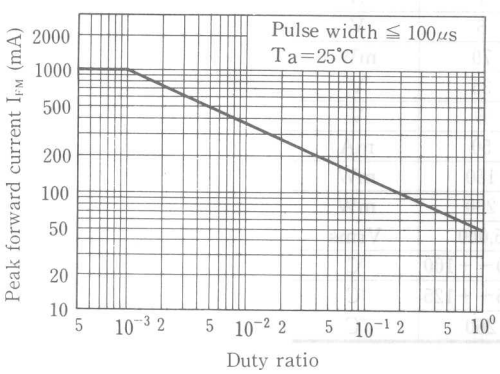


Fig. 4 Forward Current vs. Forward Voltage

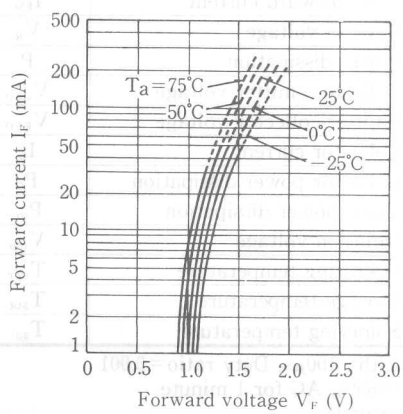


Fig. 5 Current Transfer Ratio vs. Forward Current

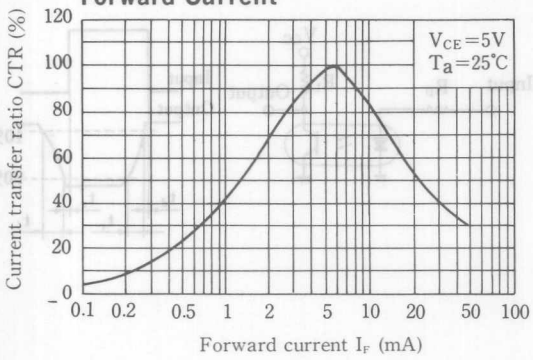


Fig. 6 Collector Current vs. Collector-emitter Voltage

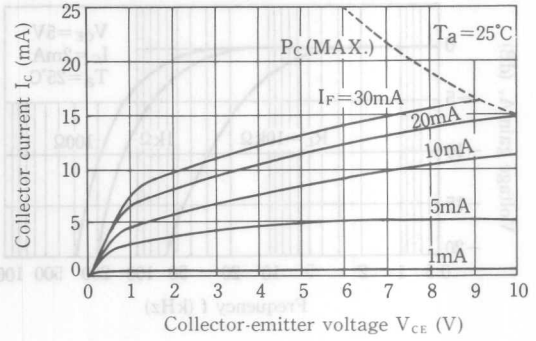


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

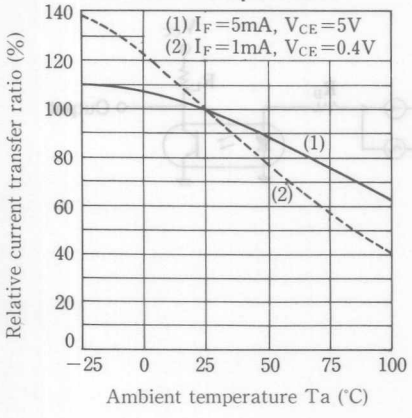


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

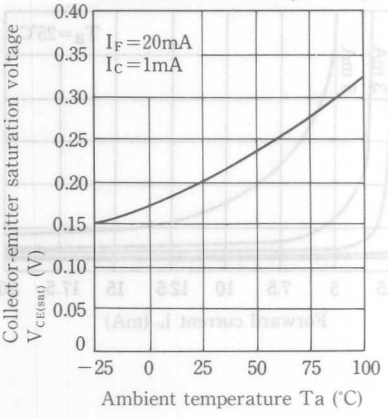


Fig. 9 Collector Dark Current vs. Ambient Temperature

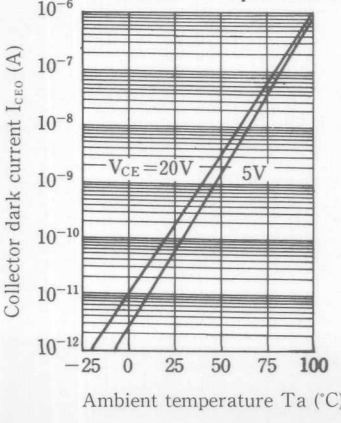
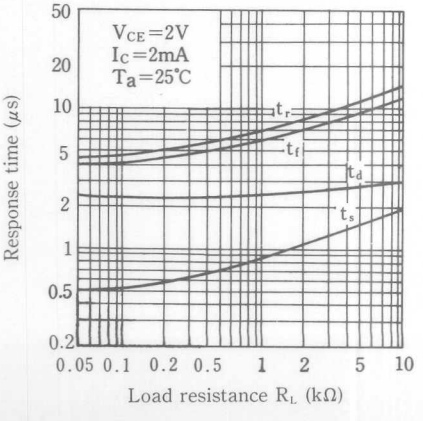
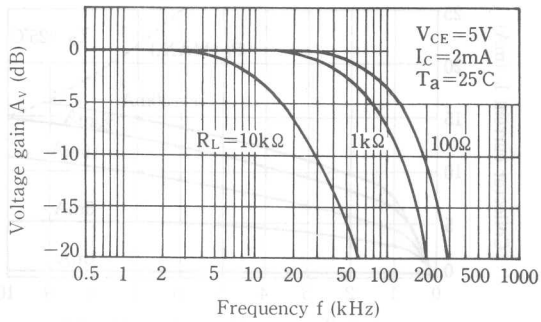


Fig. 10 Response Time vs. Load Resistance



6

Fig. 11 Frequency Response



Test Circuit for Response Time

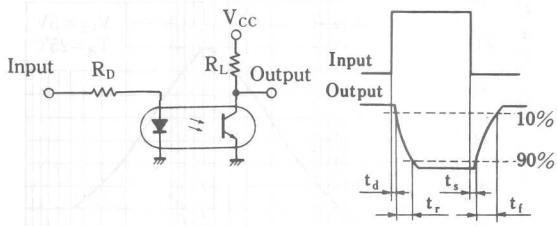
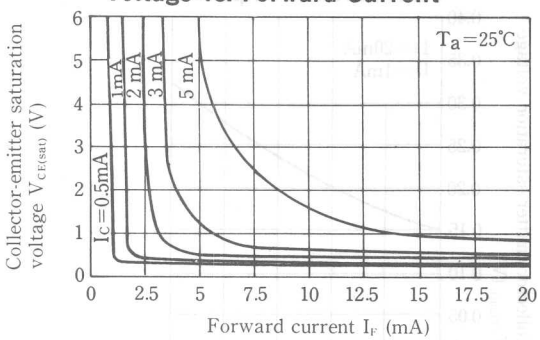
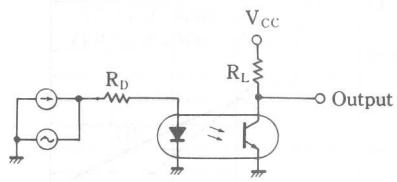


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



PC851 High Collector-emitter Voltage Type Photocoupler

※Lead forming type (I type) is also available. (PC851I) (Page 482)

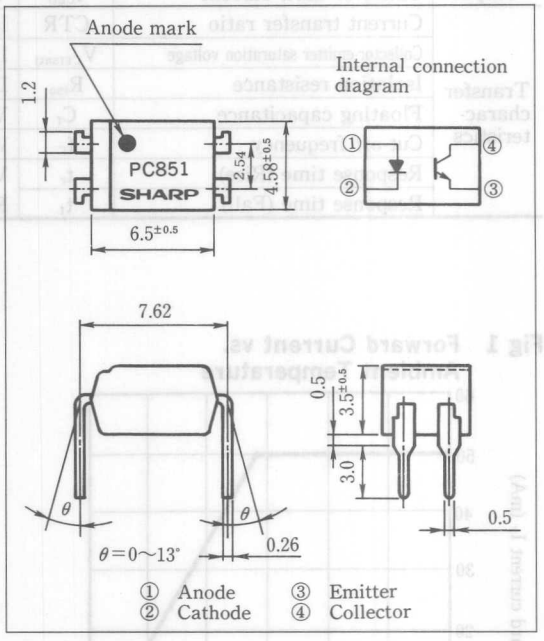
■ Features

1. High collector-emitter voltage (V_{CEO} : 300V)
2. High isolation voltage between input and output (V_{iso} : 5,000Vrms)
3. Compact dual-in-line package
4. UL recognized, file No. E64380

■ Applications

1. On-off switching for transmisson/ reception circuit for telephone
2. Interface to various power supply circuits, power patch boards
3. Copiers, facsimiles
4. Output section for numerical control machines
5. Controller for SSRs, DC motors

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power disspation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	300	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
	Total power dssipation	P_{tot}	200	mW
	*2Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−25~+100	°C
	Storage temperature	T_{stg}	−55~+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100us, Duty ratio=0.01
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=200V, I_F=0	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	40	80	—	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.1	0.3	V
	Isolation resistance	R_{iso}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω	—	50	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	4	10	μs
	Response time (Fall)	t_f	R_L=100Ω	—	5	12	μs

Fig 1 Forward Current vs. Ambient Temperature

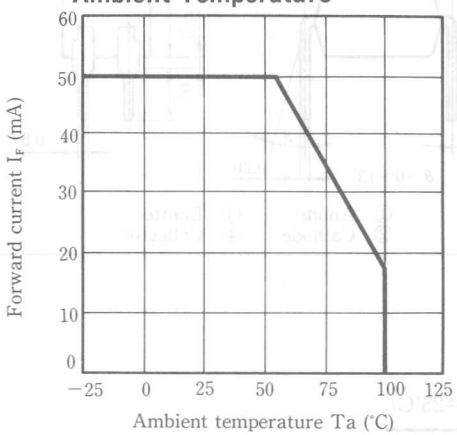


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

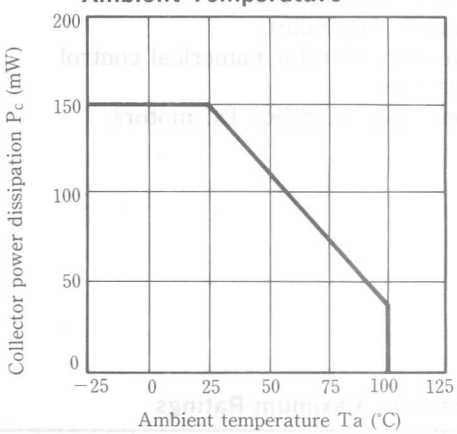


Fig. 3 Peak Forward Current vs. Duty Ratio

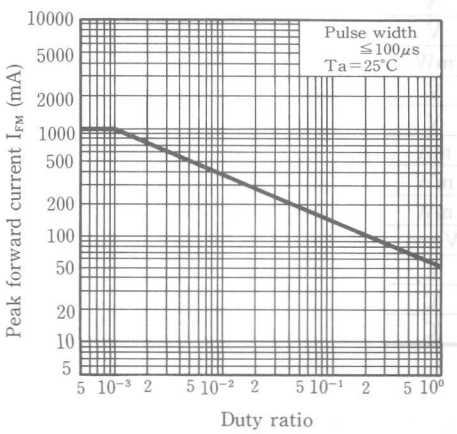


Fig. 4 Forward Current vs. Forward Voltage

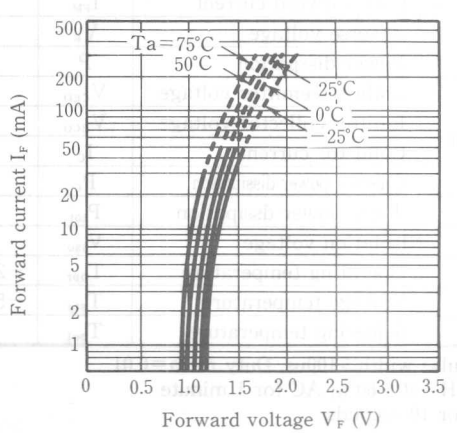


Fig. 5 Current Transfer Ratio vs. Forward Current

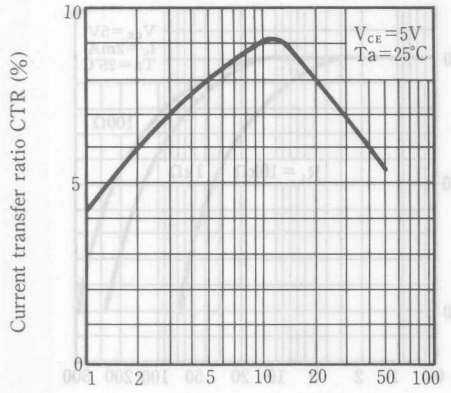


Fig. 6 Collector Current vs. Collector-emitter Voltage

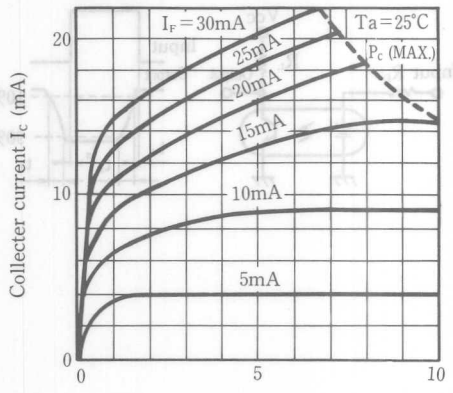


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

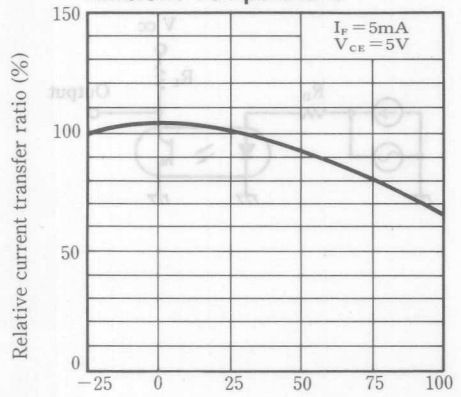


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

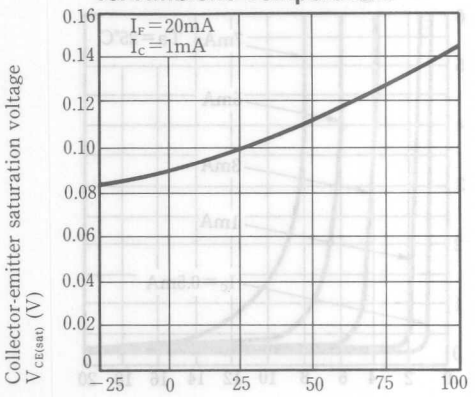


Fig. 9 Collectr Dark Current vs. Ambient Temperature

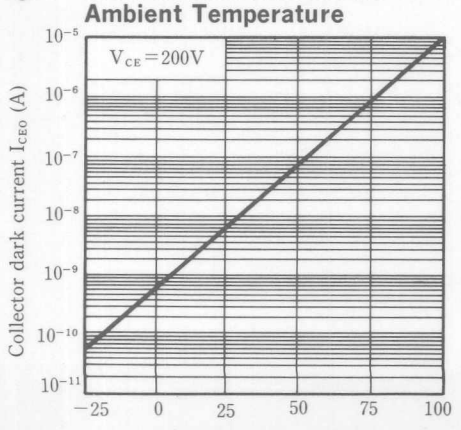
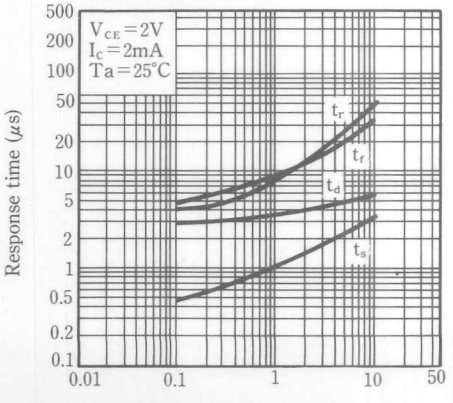


Fig. 10 Response Time vs. Load Resistance



6

Test Circuit for Response Time

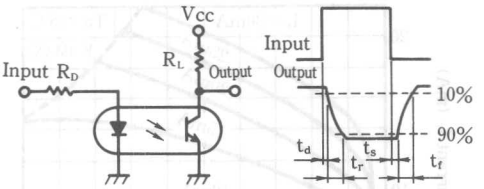


Fig. 11 Frequency Response

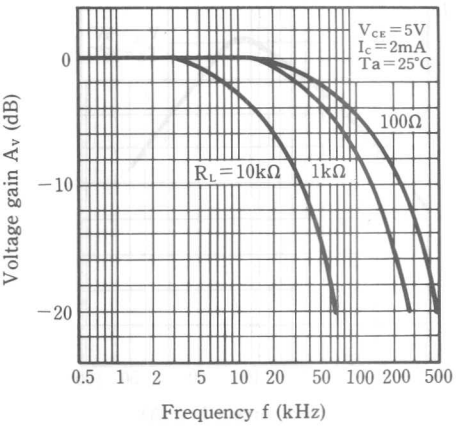
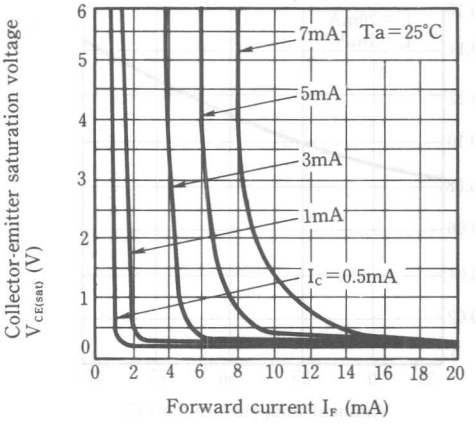
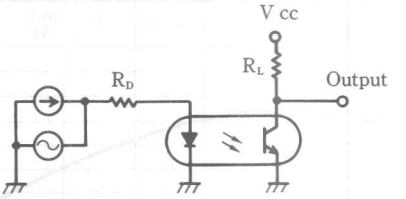


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



PC852 Series PC853/PC853H High Collector-emitter Voltage Type Photocouplers

■ Features

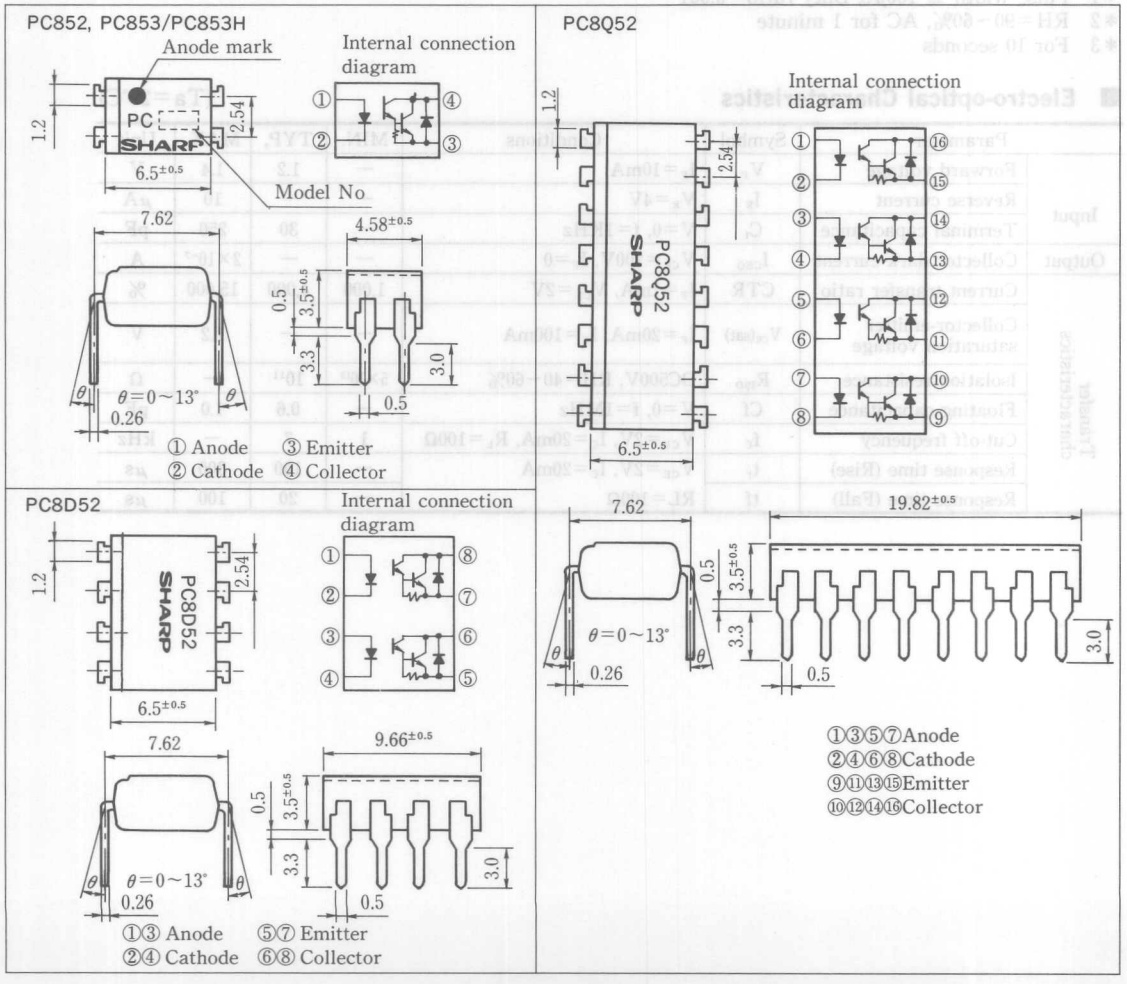
1. High collector-emitter voltage
   PC852 Series, PC853(V_{CEO}: 300V)
   PC853H (V_{CEO}: 350V)
2. High current transfer ratio
   (CTR: MIN. 1000% at I_F=1mA, V_{CE}=2V)
3. High isolation voltage between input and output (V_{iso}: 5,000V_{rms})
4. Compact dual-in-line package
   PC852,PC853,PC853H(1-channel type)
   PC8D52 (2-channel type)
   PC8Q52 (4-channel type)
5. Large collector power dissipation.
   PC853, PC853H (P_C: 300mW)

■ Applications

1. Telephone sets
2. Copiers, facsimiles
3. Interface with various power supply circuits, power distribution boards
4. Numerical control machines

■ Outline Dimensions

(Unit: mm)



6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating			Unit
			PC852 Series	PC853	PC853H	
Input	Forward current	I_F	50	50		mA
	*1Peak forward current	I_{FM}	1	1		A
	Reverse voltage	V_R	6	6		V
	Power dissipation	P	70	70		mW
Output	Collector-emitter voltage	V_{CEO}	300	300	350	V
	Emitter-collector voltage	V_{ECO}	0.1	0.1		V
	Collector current	I_C	150	150		mA
	Collector power dissipation	P_C	150	300		mW
Total power dissipation		P_{tot}	200	320		mW
*2Isolation voltage		V_{iso}	5,000	5,000		V_{rms}
Operating temperature		T_{opr}	−30～+100	−30～+100		°C
Storage temperature		T_{stg}	−55～+125	−55～+125		°C
*3Soldering temperature		T_{sol}	260	260		°C

*1 Pulse width ≦ 100μs, Duty ratio=0.001
*2 RH=90～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=10mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1KHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=200V, I_F=0	—	—	2×10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	1,000	4,000	15,000	%
	Collector-emitter saturation voltage	V_{CE}(sat)	I_F=20mA, I_C=100mA	—	—	1.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	Cf	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_C	V_{CE}=2V, I_C=20mA, R_L=100Ω	1	7	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=20mA	—	100	300	μs
	Response time (Fall)	tf	RL=100Ω	—	20	100	μs

Fig. 1 Forward Current vs. Ambient Temperature

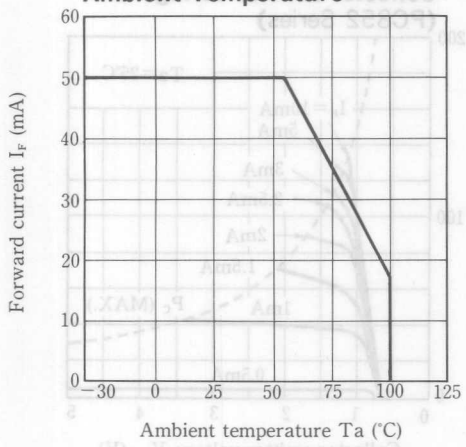


Fig. 2 Collector Power Dissipation vs. Ambient Temperature (PC852 Series)

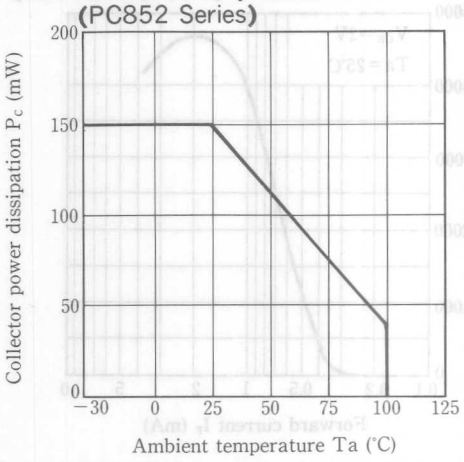


Fig. 3 Collector Power Dissipation vs. Ambient Temperature (PC853/PC853H)

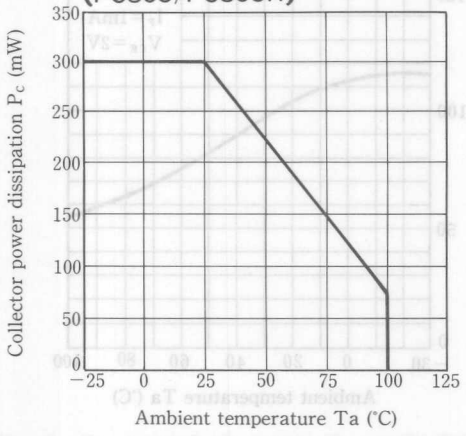


Fig. 4 Peak Forward Current vs. Duty Ratio

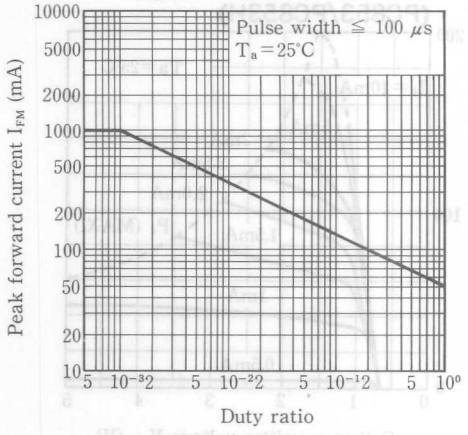


Fig. 5 Forward Current vs. Forward Voltage

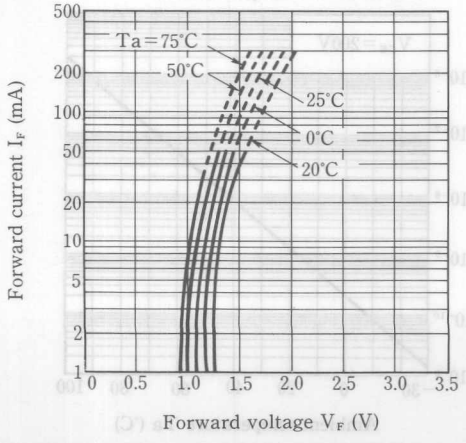
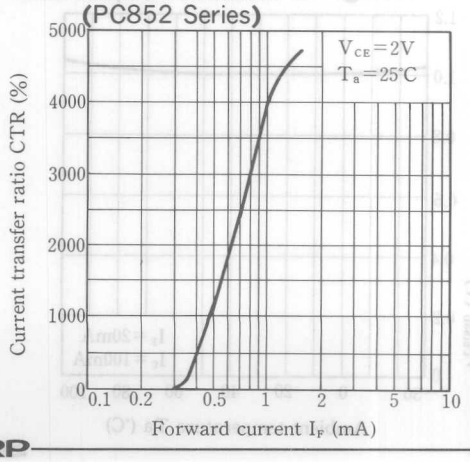


Fig. 6 Current Transfer Ratio vs. Forward Current (PC852 Series)



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Fig. 7 Current Transfer Ratio vs. Forward Current (PC853/PC853H)

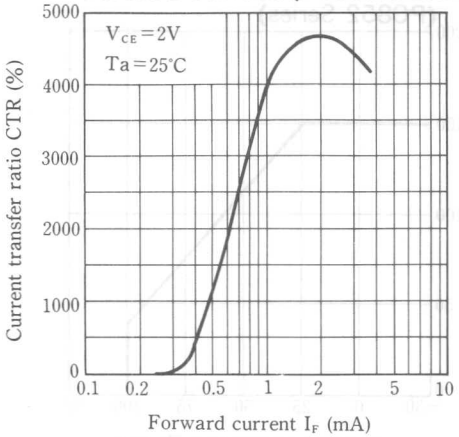


Fig. 8 Collector Current vs. Collector-emitter voltage (PC852 Series)

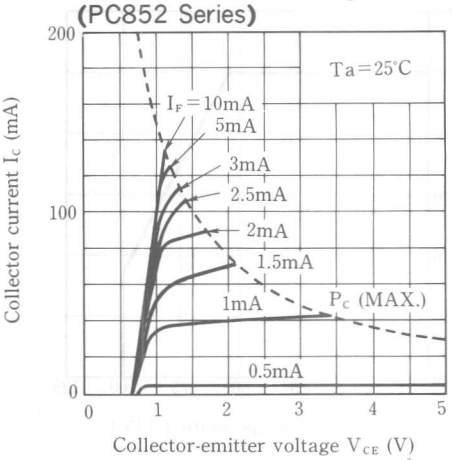


Fig. 9 Collector Current vs. Collector-emitter voltage (PC853/PC853H)

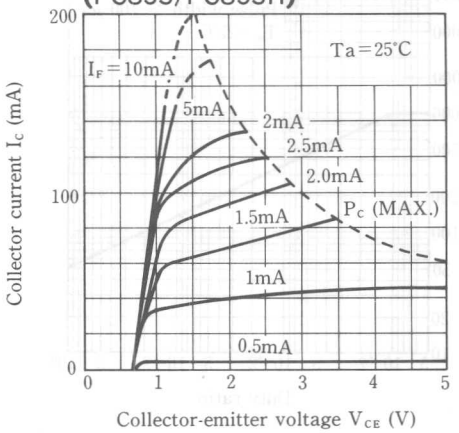


Fig. 10 Relative Current Transfer Ratio vs. Ambient Temperature

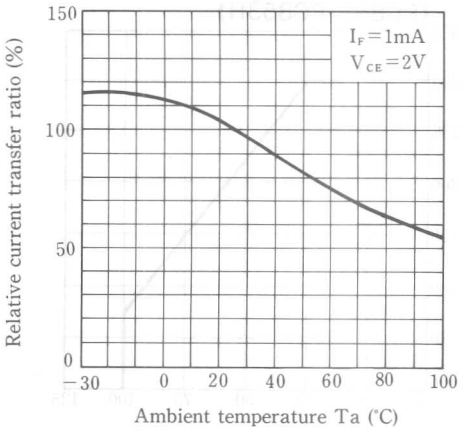


Fig. 11 Collector-emitter Saturation Voltage vs. Ambient Temperature

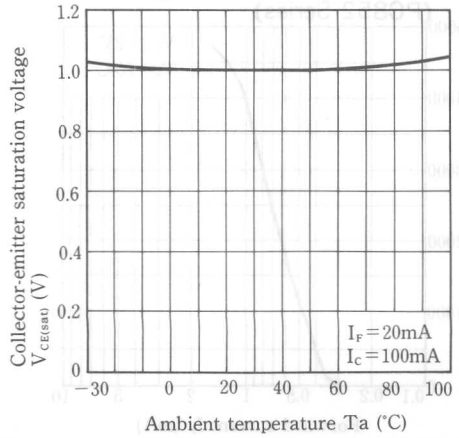


Fig. 12 Collector Dark Current vs. Ambient Temperature

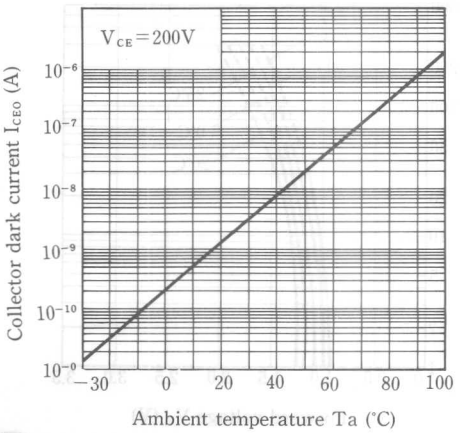


Fig. 13 Response Time vs. Load Resistance

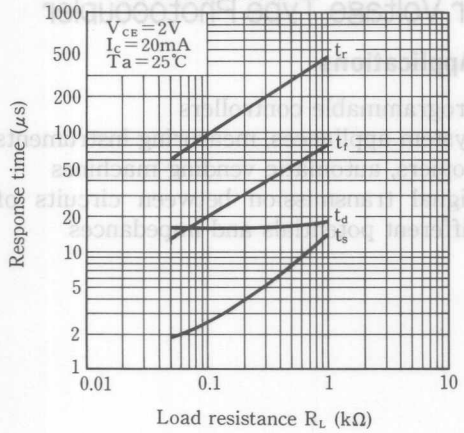


Fig. 14 Frequency Response

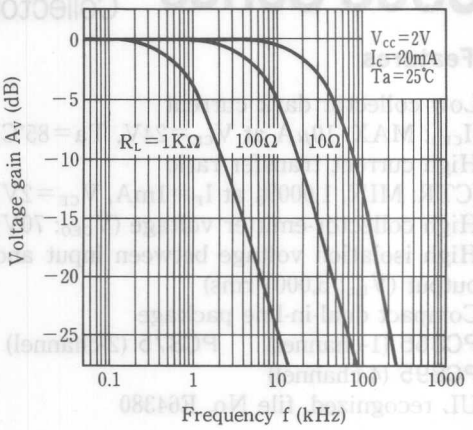
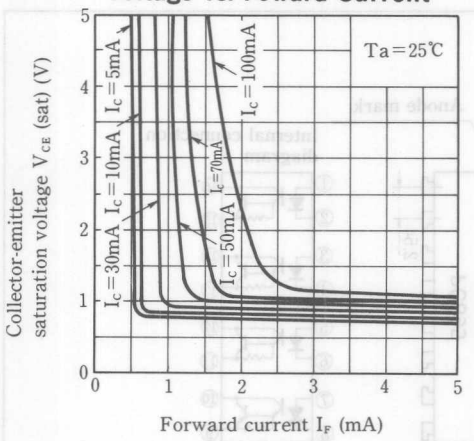


Fig. 15 Collector-emitter Saturation Voltage vs. Foward Current



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PC865 Series

High Sensitivity, Low Collector Dark Current, High Collector-emitter Voltage Type Photocoupler

■ Features

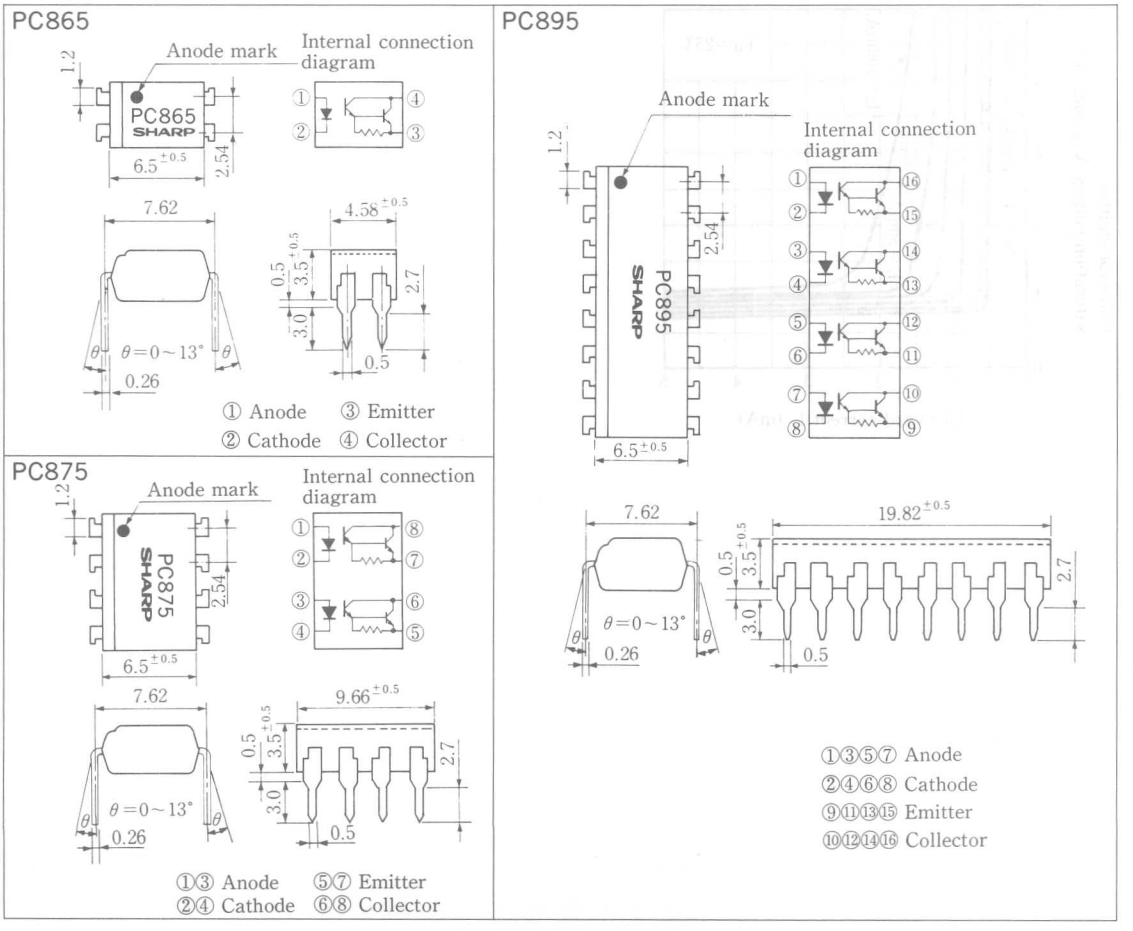
1. Low collector dark current
   (I_{CEO}: MAX. 10μA at V_{CE}=24V, Ta=85°C)
2. High current transfer ratio
   (CTR: MIN. 1,000% at I_F=1mA, V_{CE}=2V)
3. High collector-emitter voltage (V_{CEO}: 70V)
4. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
5. Compact dual-in-line package
   PC865 (1-channel) PC875 (2-channel)
   PC895 (4-channel)
6. UL recognized, file No. E64380

■ Applications

1. Programmable controllers
2. System appliances, measuring instruments
3. Copiers, automatic vending machines
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions

(Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	70	V
	Emitter-collector voltage	V_{ECO}	0.1	V
	Collector current	I_C	80	mA
	Collector power dissipation	P_C	150	mW
	Total power dissipation	P_{tot}	200	mW
	*2Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−30～+100	°C
	Storage temperature	T_{stg}	−55～+125	°C
	*3Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions		MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA		—	1.2	1.4	V
	Reverse current	I_R	V_R=4V		—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz		—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=24V	Ta=25°C	—	—	2×10^{-7}	A
			I_F=0	Ta=85°C	—	—	10^{-5}	A
Transfer characteristics	*4Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V		1,000	—	—	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=5mA		—	0.8	1.0	V
	Isolation resistance	R_{iso}	DC500V, RH=40～60%		5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz		—	0.6	1.0	pF
	Cut-off frequency	f_C	V_{CE}=2V, I_C=20mA, R_L=100Ω		1	6	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=10mA		—	100	300	μs
	Response time (Fall)	t_f	R_L=100Ω		—	35	200	μs

Fig. 1 Forward Current vs. Ambient Temperature

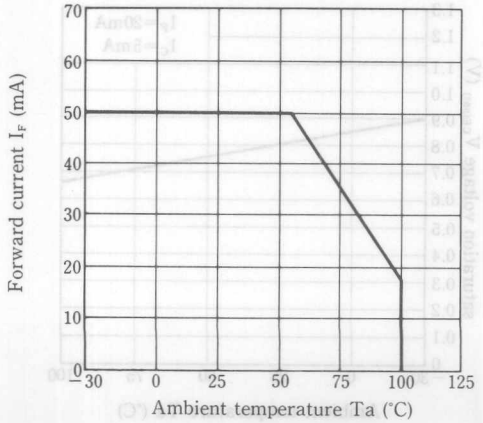
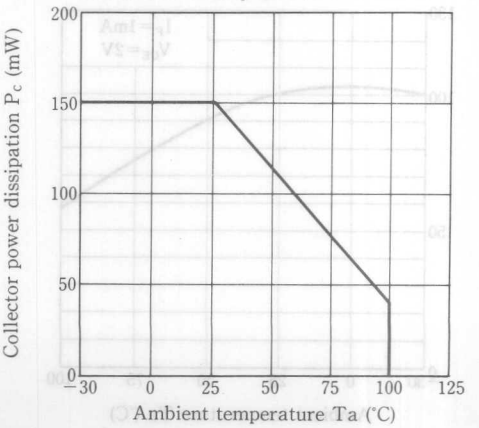


Fig. 2 Collector Power Dissipation vs. Ambient Temperature



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Fig. 3 Peak Forward Current vs. Duty Ratio

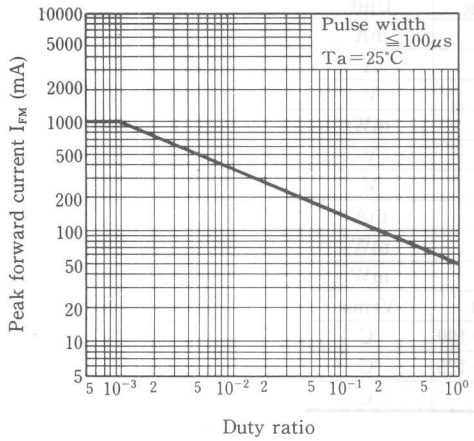


Fig. 4 Forward Current vs. Forward Voltage

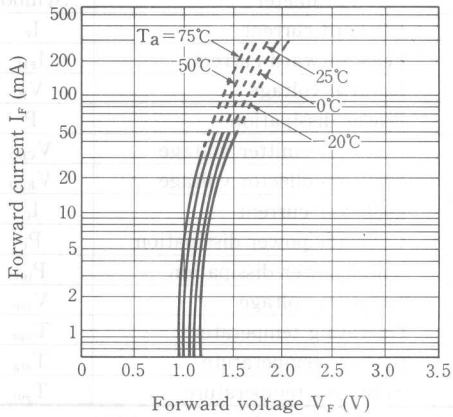


Fig. 5 Current Transfer Ratio vs. Forward Current

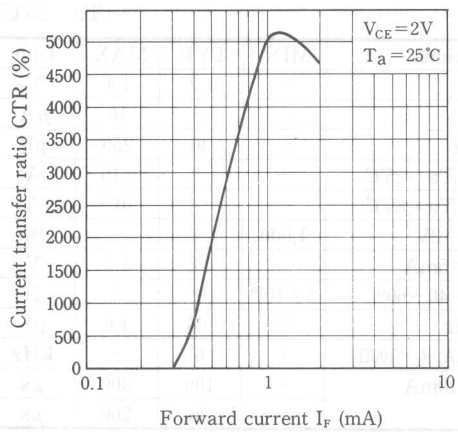


Fig. 6 Collector Current vs. Collector-emitter Voltage

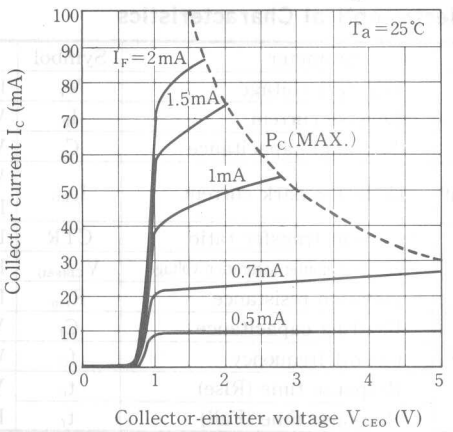


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

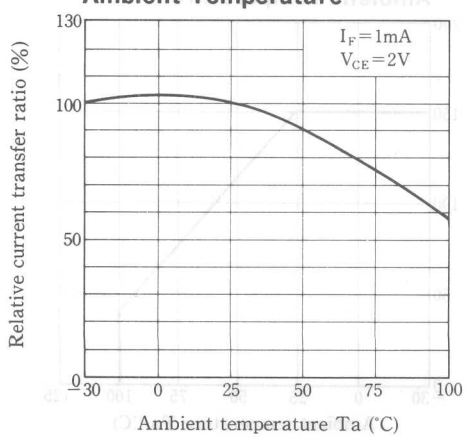


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

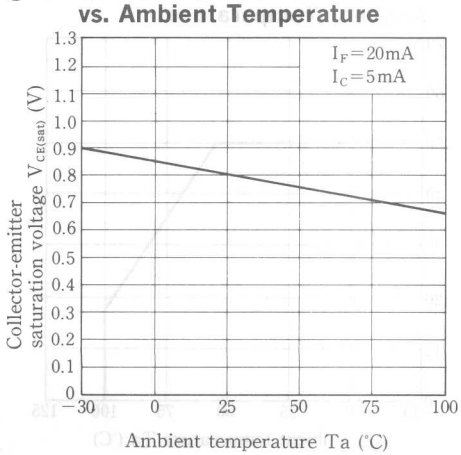


Fig. 9 Collector Dark Current vs. Ambient Temperature

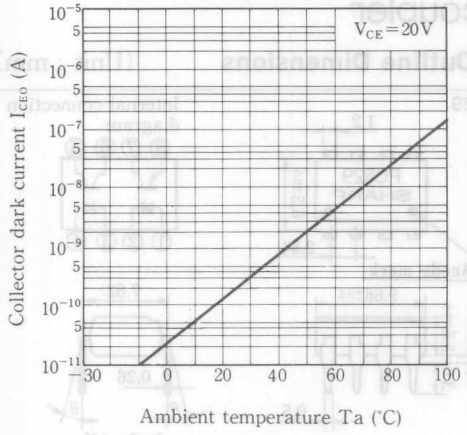


Fig. 10 Response Time vs. Load Resistance

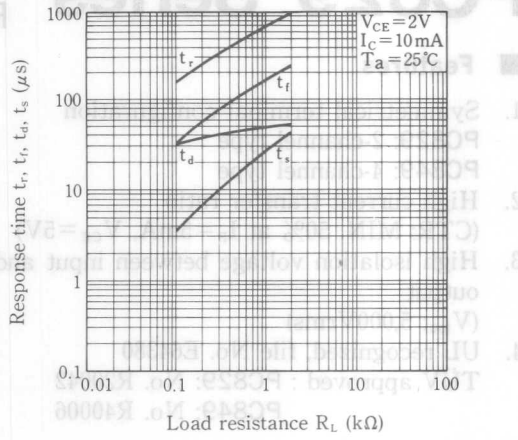
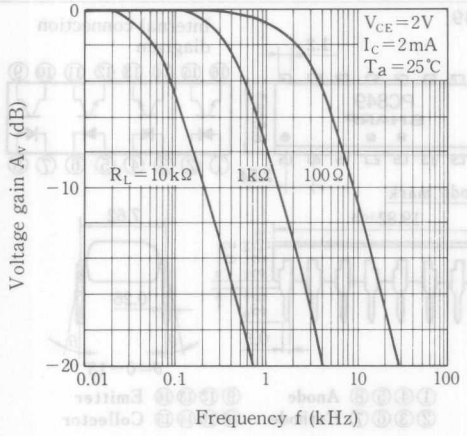
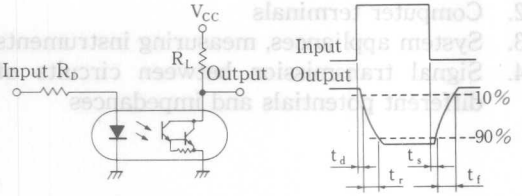


Fig. 11 Frequency Response



Test Circuit for Response Time



Test Circuit for Frequency Response

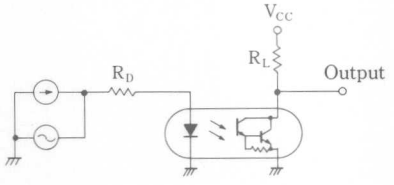
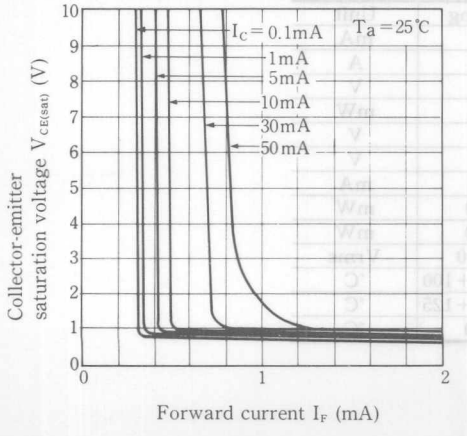


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



6

PC829 Series High Density Mounting Type Photocoupler

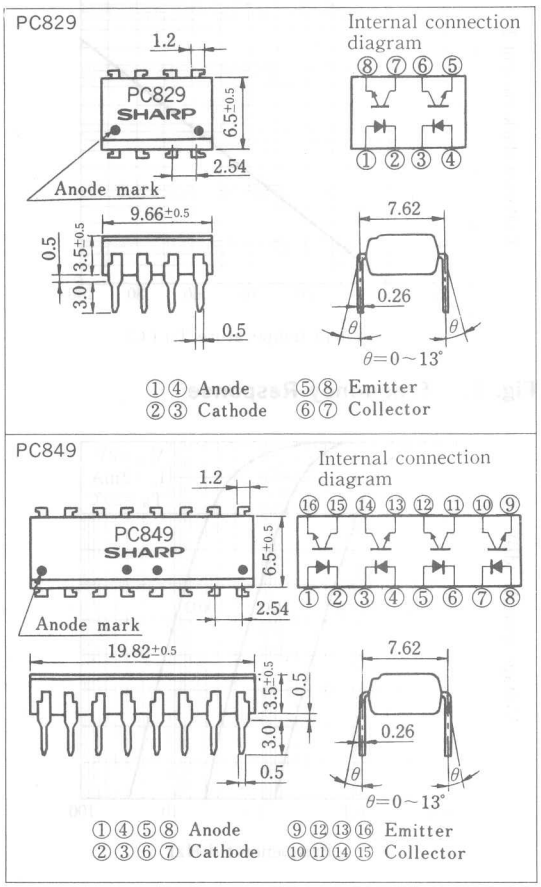
■ Features

1. Symmetrical terminal configuration
   PC829: 2-channel type
   PC849: 4-channel type
2. High current transfer ratio
   (CTR: MIN. 50% at I_F=5mA, V_{CE}=5V)
3. High isolation voltage between input and output
   (V_{iso}: 5,000Vrms)
4. UL recognized, file No. E64380
   TÜV approved : PC829: No. R20042
   PC849: No. R40006

■ Applications

1. Telephone exchangers
2. Computer terminals
3. System appliances, measuring instruments
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	170	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25~+100	°C
Storage temperature		T_{stg}	−40~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	3.0	V
	Reverse current	I_R	V_R=4V	—	—	10	μA
	Terminal capacitance	C_t	V=0, f=1kHz	—	30	250	pF
Output	Collector dark current	I_{CEO}	V_{CE}=20V, I_F=0	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	50	—	400	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	—	0.1	0.2	V
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF
	Cut-off frequency	f_c	V_{CE}=5V, I_C=2mA, R_L=100Ω	—	80	—	kHz
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	4	15	μs
	Response time (Fall)	t_f		—	3	15	μs

Fig. 1 Forward Current vs. Ambient Temperature

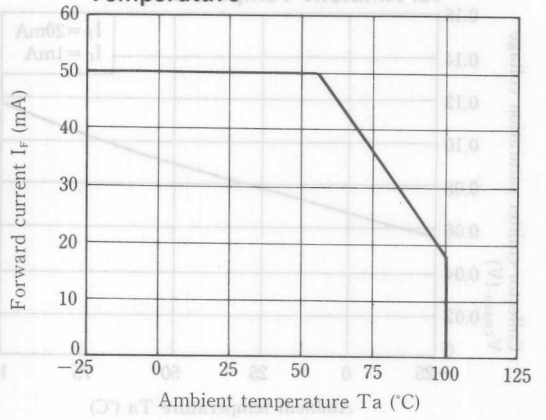


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

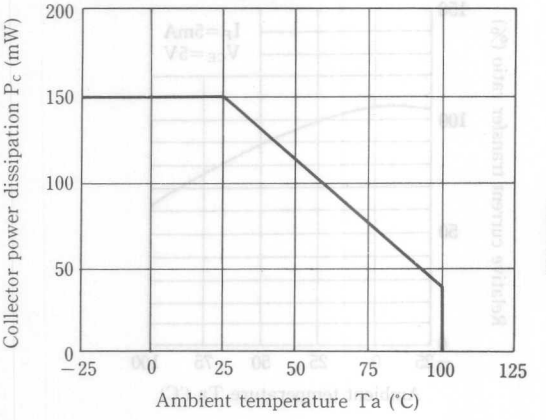


Fig. 3 Peak Forward Current vs. Duty Ratio

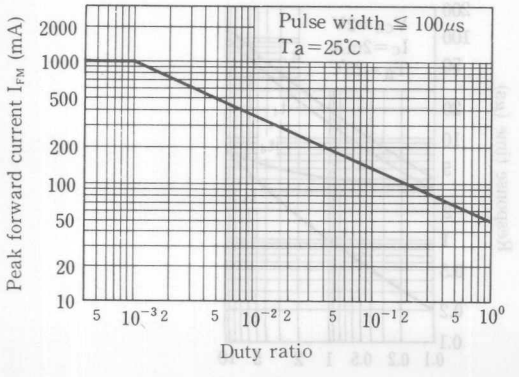
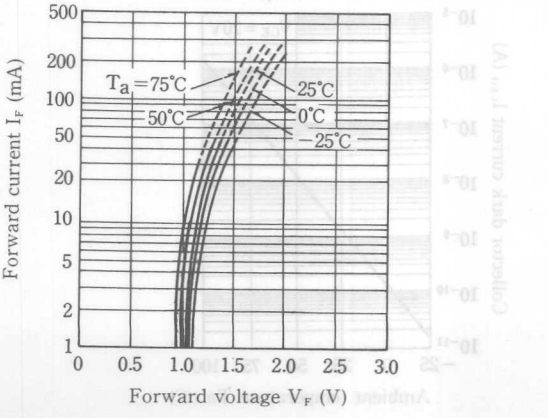


Fig. 4 Forward Current vs. Forward Voltage



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Fig. 5 Current Transfer Ratio vs. Forward Current

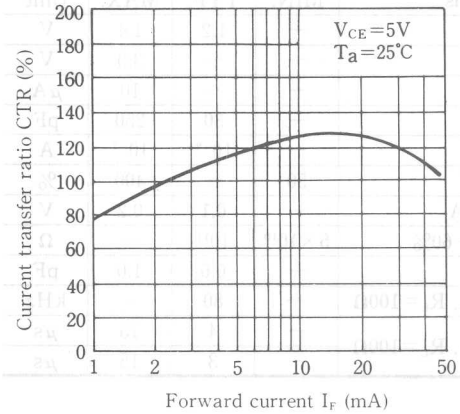


Fig. 6 Collector Current vs. Collector-emitter Voltage

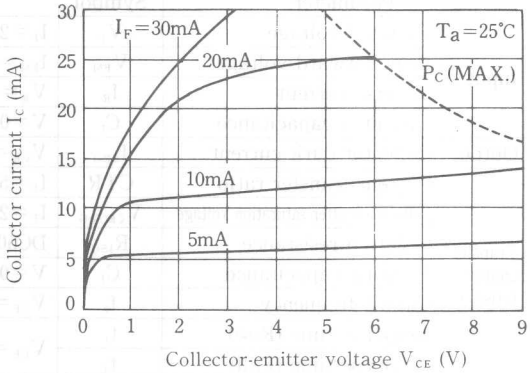


Fig. 7 Relative Current Transfer Ratio vs. Ambient Temperature

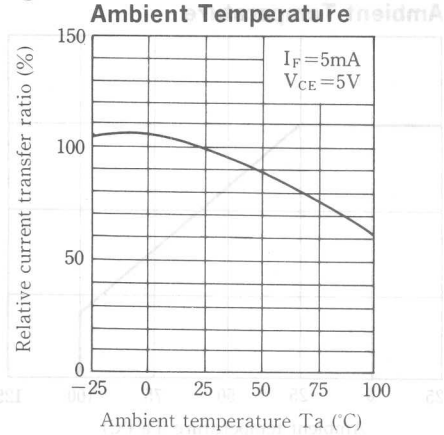


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

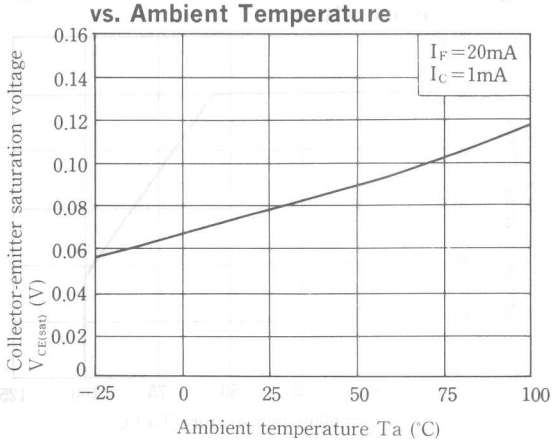


Fig. 9 Collector Dark Current vs. Ambient Temperature

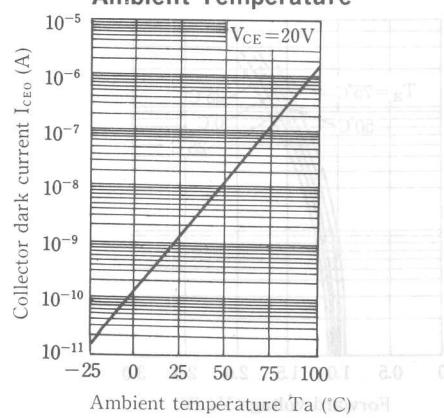


Fig. 10 Response Time vs. Load Resistance

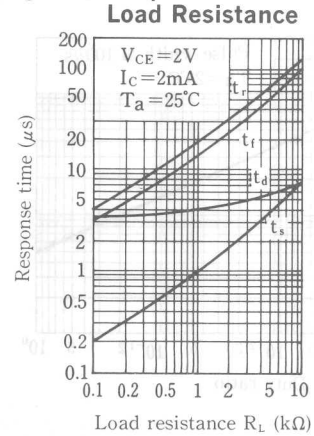
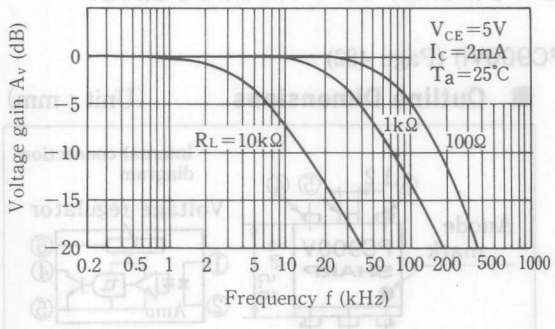


Fig. 11 Frequency Response



Test Circuit for Response Time

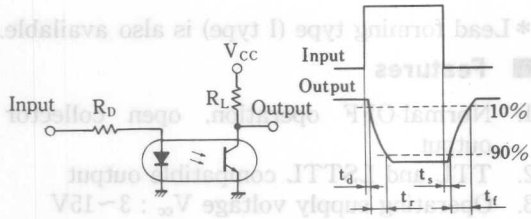
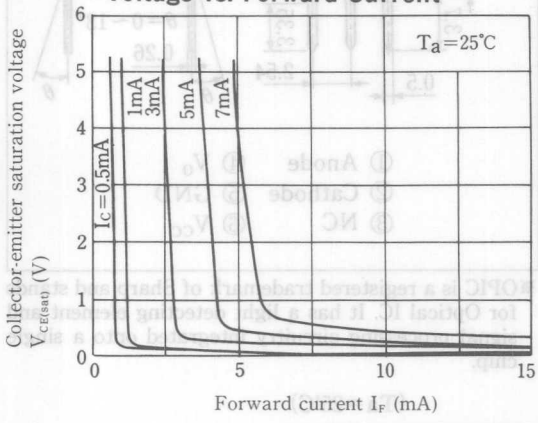
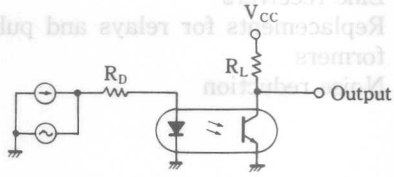


Fig. 12 Collector-emitter Saturation Voltage vs. Forward Current



Test Circuit for Frequency Response



6

PC900V Digital Output Type OPIC Photocoupler

*Lead forming type (I type) is also available. (PC900VI) (Page 482)

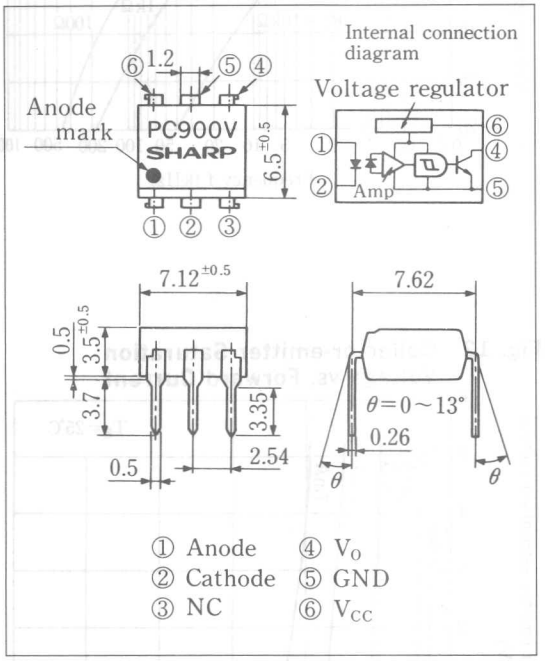
■ Features

1. Normal-OFF operation, open collector output
2. TTL and LSTTL compatible output
3. Operating supply voltage V_{cc} : 3~15V
4. High isolation voltage between input and output (V_{iso} : 5,000Vrms)
5. UL recognized, file No. E64380
   TÜV approved, No. R20043

■ Applications

1. Isolation between logic circuits
2. Logic level shifters
3. Line receivers
4. Replacements for relays and pulse transformers
5. Noise reduction

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Supply voltage	V_{CC}	16	V
	High level output voltage	V_{OH}	16	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	150	mW
Total power dissipation		P_{tot}	170	mW
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25~+85	°C
Storage temperature		T_{stg}	−40~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=0~+70°C unless specified)

	Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=4mA	–	1.1	1.4	V
				I_F=0.3mA	0.7	1.0	–	
	Reverse current		I_R	Ta=25°C, V_R=3V	–	–	10	μA
	Terminal capacitance		C_t	Ta=25°C, V=0, f=1kHz	–	30	250	pF
Output	Operating supply voltage		V_{CC}		3	–	15	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=4mA	–	0.2	0.4	V
	High level output voltage		I_{OH}	V_O=V_{CC}=15V, I_F=0	–	–	100	μA
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=4mA	–	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=0	–	1.0	5.0	mA
Transfer characteristics	*4"High→Low" threshold input current		I_{FHL}	Ta=25°C, V_{CC}=5V, R_L=280Ω	–	1.1	2.0	mA
				V_{CC}=5V, R_L=280Ω	–	–	4.0	
	*5"Low→High" threshold input current		I_{FLH}	Ta=25°C, V_{CC}=5V, R_L=280Ω	0.4	0.8	–	mA
				V_{CC}=5V, R_L=280Ω	0.3	–	–	
	*6Hysteresis		I_{FLH}/I_{FHL}	V_{CC}=5V, R_L=280Ω	0.5	0.7	0.9	–
	Isolation resistance		R_{ISO}	Ta=25°C, DC500V, RH=40~60%	5×10^{10}	10^{11}	–	Ω
	Response time	"High→Low" propagation time	t_{PHL}	Ta=25°C, V_{CC}=5V, I_F=4mA, R_L=280Ω	–	1	3	μs
		"Low→High" propagation time	t_{PLH}		–	2	6	
		Fall time	t_f		–	0.05	0.5	
		Rise time	t_r		–	0.1	0.5	

*4 I_{FHL} represents forward current when output goes from high to low.
*5 I_{FLH} represents forward current when output goes from low to high.
*6 Hysteresis stands tor I_{FLH}/I_{FHL}.
*7 Test circuit for response time is shown below.

〈Precautions for Use〉

Connect a capacitor of more than 0.1μF between V_{CC} and GND.

6

Test Circuit for Response Time

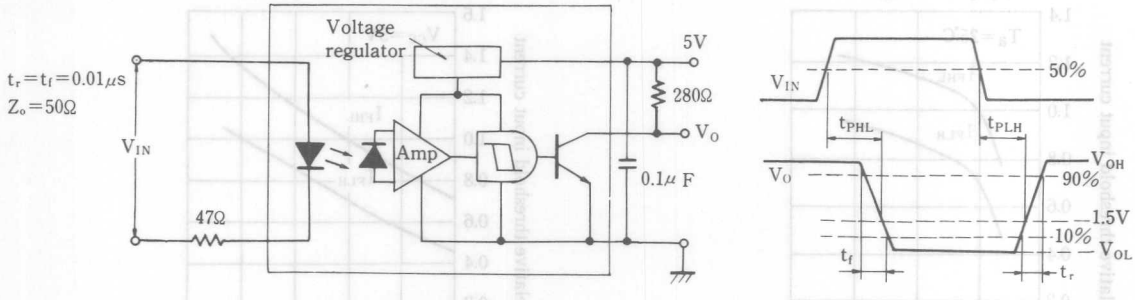


Fig. 1 Forward Current vs. Ambient Temperature

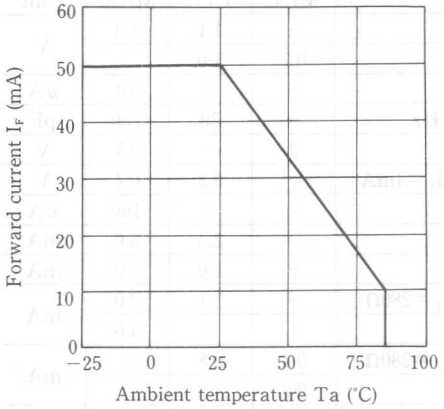


Fig. 2 Output Power Dissipation vs. Ambient Temperature

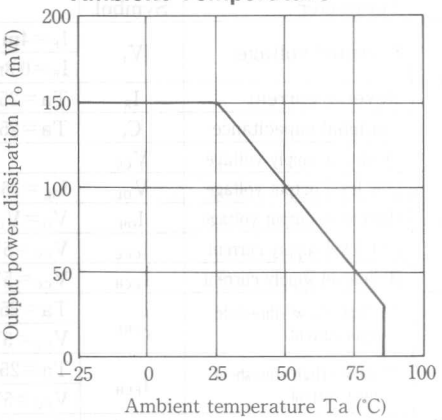


Fig. 3 Total Power Dissipation vs. Ambient Temperature

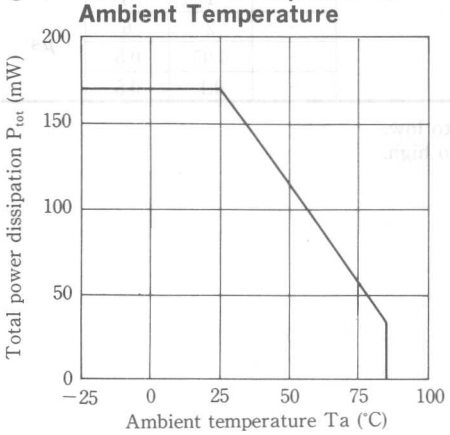


Fig. 4 Forward Current vs. Forward Voltage

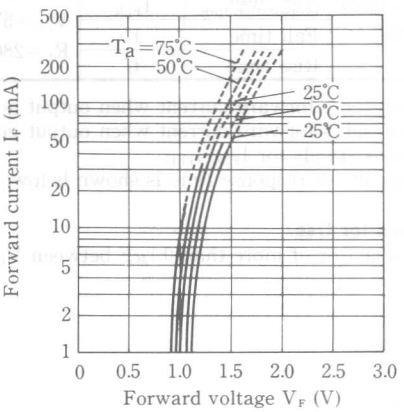


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

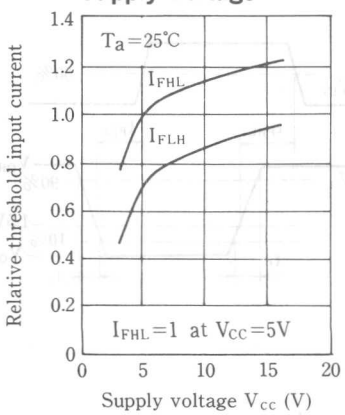


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

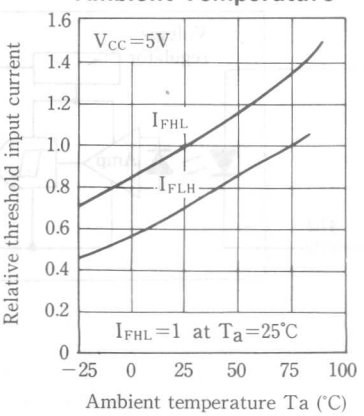


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

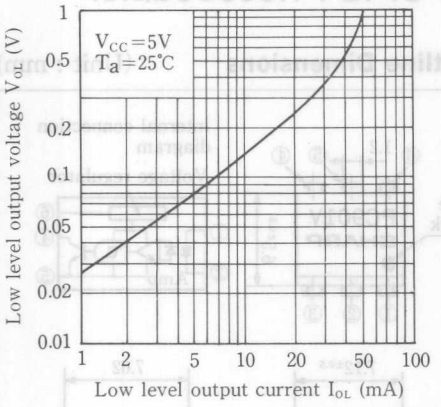


Fig. 8 Low Level Output Voltage vs. Ambient Temperature

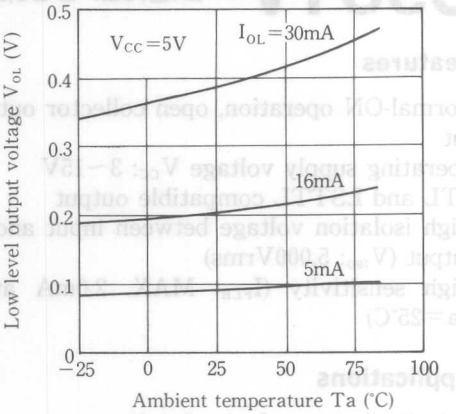


Fig. 9 Supply Current vs. Supply Voltage

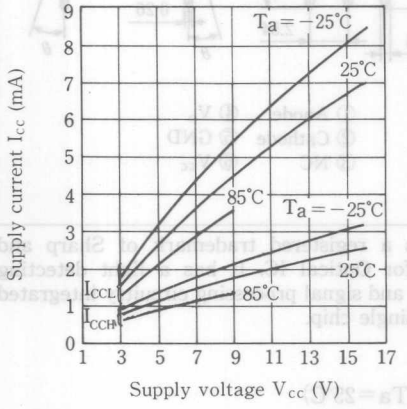


Fig. 10 Propagation Time vs. Forward Current

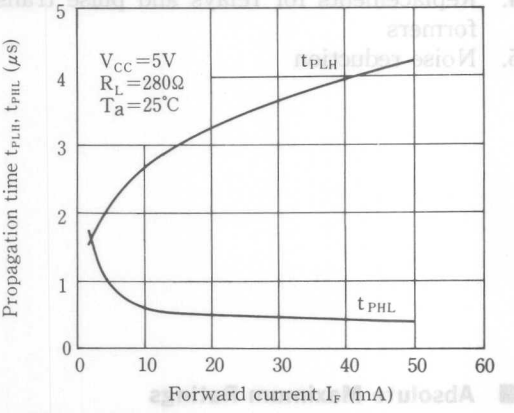
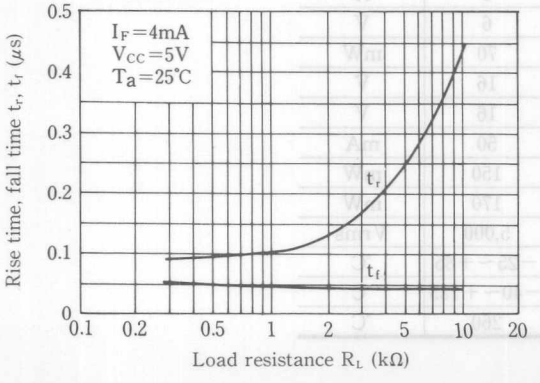


Fig. 11 Rise Time, Fall Time vs. Load Resistance



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PC901V Digital Output Type OPIC Photocoupler

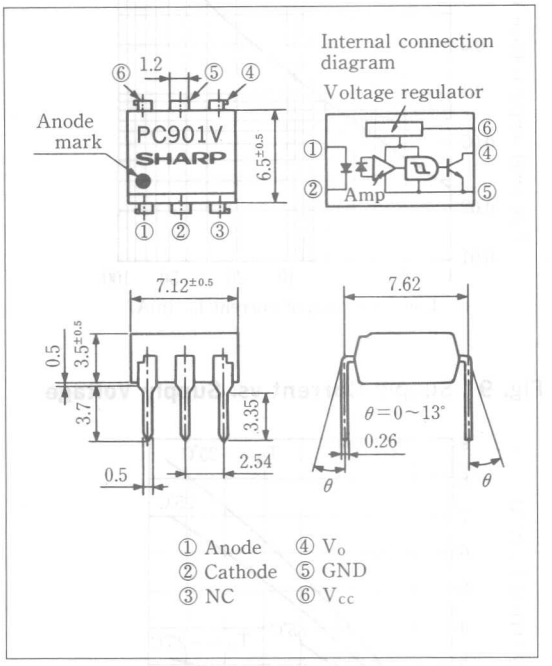
■ Features

1. Normal-ON operation, open collector output
2. Operating supply voltage V_{CC}: 3~15V
3. TTL and LSTTL compatible output
4. High isolation voltage between input and output (V_{iso}: 5,000Vrms)
5. High sensitivity (I_{FLH}: MAX. 2.0mA at Ta=25°C)

■ Applications

1. Isolation between logic circuits
2. Logic level shifters
3. Line receivers
4. Replacements for relays and pulse transformers
5. Noise reduction

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Supply voltage	V_{CC}	16	V
	High level output voltage	V_{OH}	16	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	150	mW
Total power dissipation		P_{tot}	170	mW
Isolation voltage		V_{iso}	5,000	Vrms
*2Operating temperature		T_{opr}	−25~+85	°C
Storage temperature		T_{stg}	−40~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

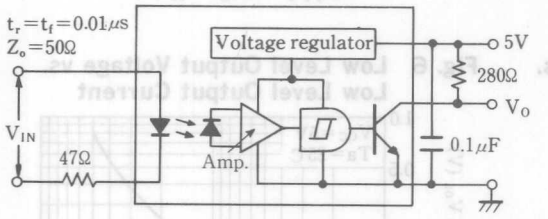
■ Electro-optical Characteristics (Ta=0~+70°C unless specified)

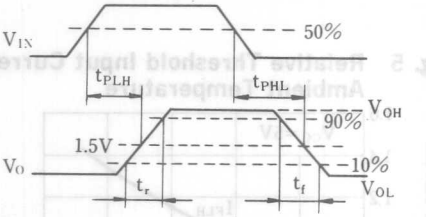
Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=4mA	—	1.1	1.4	V
				I_F=0.3mA	0.7	1.0	—	
	Reverse current		I_R	Ta=25°C, V_R=3V	—	—	10	μA
	Terminal capacitance		C_t	Ta=25°C, V=0, f=1kHz	—	30	250	pF
Output	Operating supply voltage		V_{CC}		3	—	15	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=0	—	0.2	0.4	V
	High level output current		I_{OH}	V_O=V_{CC}=15V, I_F=4mA	—	—	100	μA
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=4mA	—	2.7	5.5	mA
Transfer characteristics	*4"L→H" threshold input current		I_{FLH}	Ta=25°C, V_{CC}=5V, R_L=280Ω	—	1.1	2.0	mA
				V_{CC}=5V, R_L=280Ω	—	—	4.0	
	*5"H→L" threshold input current		I_{FHL}	Ta=25°C, V_{CC}=5V, R_L=280Ω	0.4	0.8	0	mA
				V_{CC}=5V, R_L=280Ω	0.3	—	—	
	*6Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V, R_L=280Ω	0.5	0.7	0.9	—
	Isolation resistance		R_{ISO}	Ta=25°C, DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	*7Response time	"L→H" propagation time	t_{PLH}	Ta=25°C V_{CC}=5V, I_F=4mA R_L=280Ω	—	1	3	μs
		"H→L" propagation time	t_{PHL}		—	2	6	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	
	*8Instantaneous common mode rejection voltage (High level output)		CM_H	V_{CM}=600V(peak), V_O(MIN.)=2V I_F=4mA, R_L=280Ω, Ta=25°C	—	−2000	—	V/μs
	*8Instantaneous common mode rejection voltage (Low level output)		CM_L	V_{CM}=600V(peak), V_O(MAX.)=0.8V I_F=0, R_L=280Ω, Ta=25°C	—	2000	—	V/μs

*4 I_{FLH} represents forward current when output goes from low to high.
*5 I_{FHL} represents forward current when output goes from high to low.
*6 Hysterisis stands for I_{FHL}/I_{FLH}
*7 Test circuit for response time is shown below.

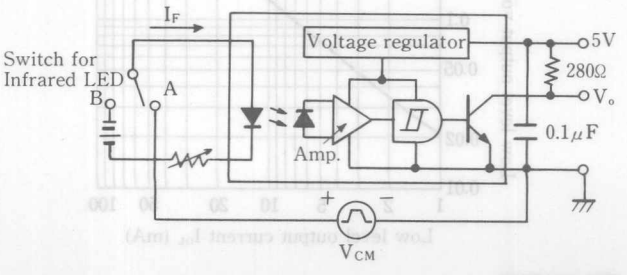
〈**Precautions for Use**〉
Connect a capacitor of more than 0.1μF between V_{CC} and GND.

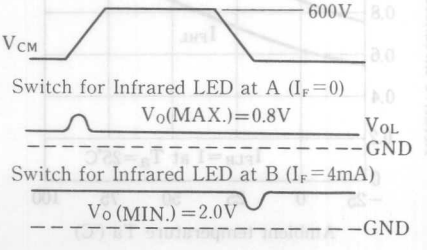
Test Circuit for Response Time





*8Test Circuit for CM_H, CM_L





6

Fig. 1 Forward Current vs. Ambient Temperature

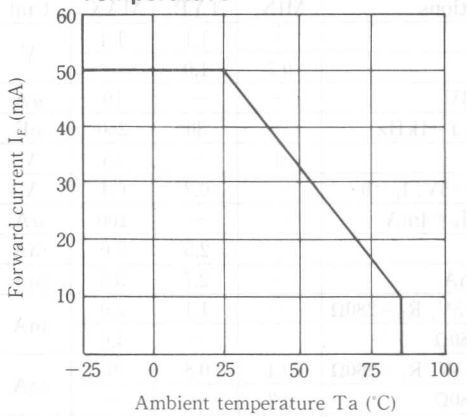


Fig. 2 Power Dissipation vs. Ambient Temperature

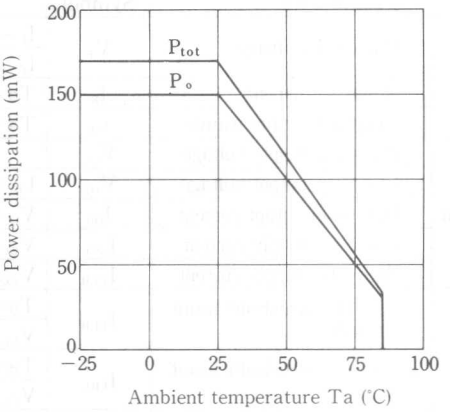


Fig. 3 Forward Current vs. Forward Voltage

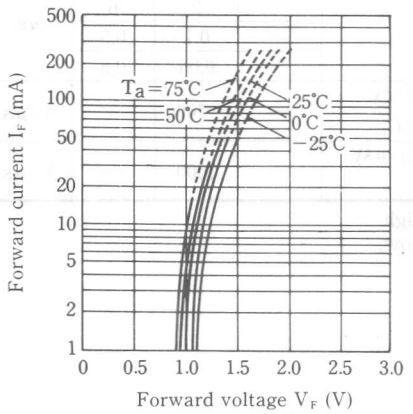


Fig. 4 Relative Threshold Input Current vs. Supply Voltage

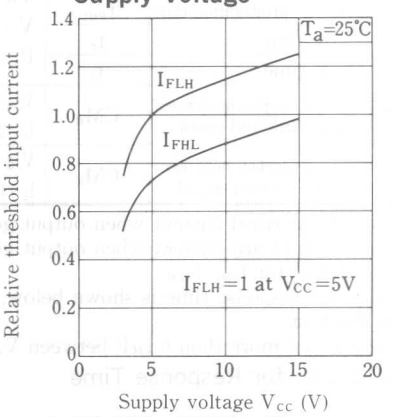


Fig. 5 Relative Threshold Input Current vs. Ambient Temperature

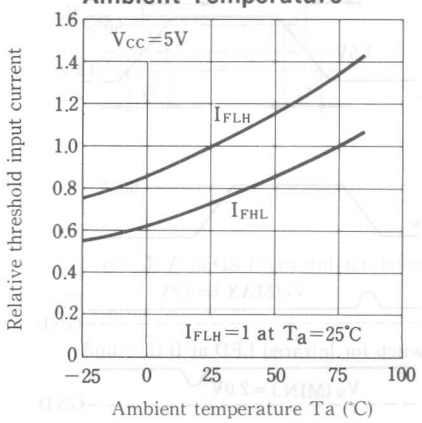


Fig. 6 Low Level Output Voltage vs. Low Level Output Current

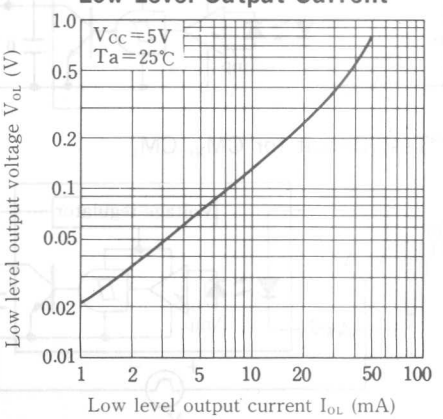


Fig. 7 Low Level Output Voltage vs. Ambient Temperature

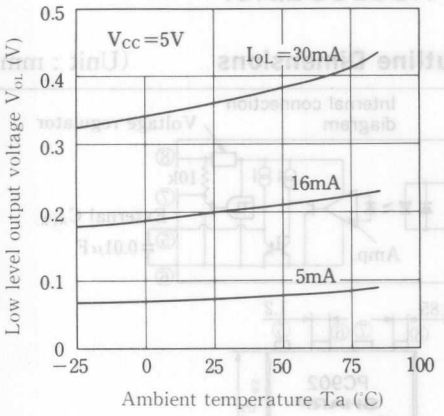


Fig. 8 High Level Output Current vs. Forward Current

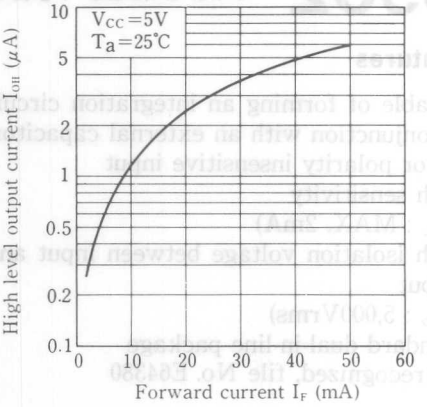


Fig. 9 High Level Output Current vs. Ambient Temperature

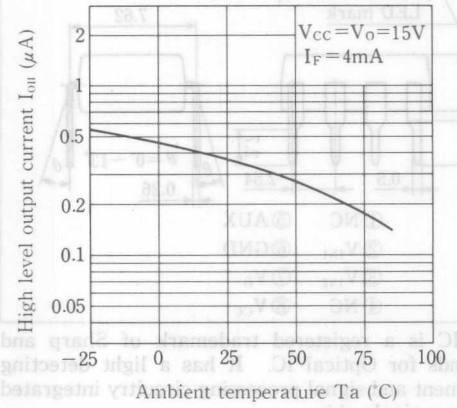


Fig. 10 Supply Current vs. Supply Voltage

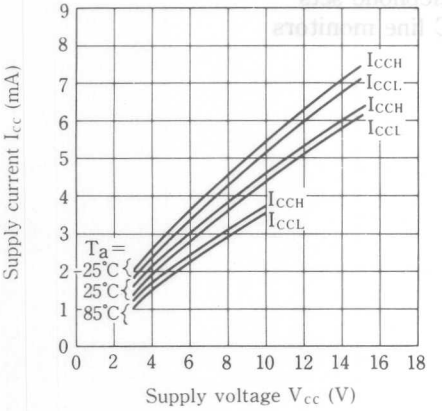


Fig. 11 Propagation Time vs. Forward Current

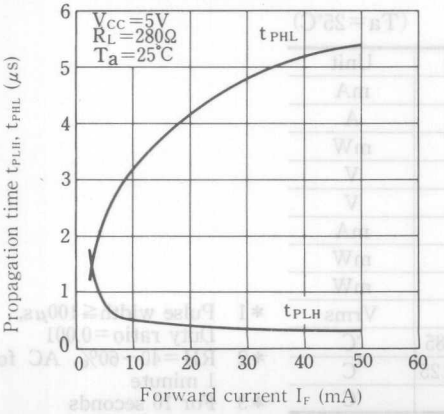
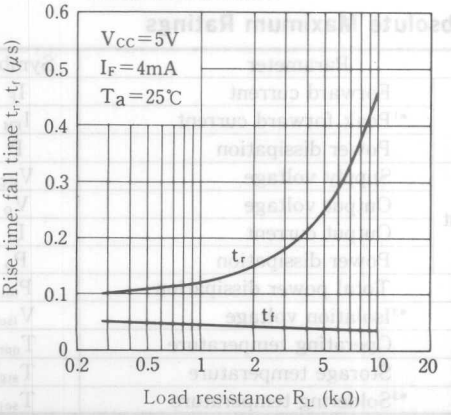


Fig. 12 Rise Time, Fall Time vs. Load Resistance



6

PC902 AC Input Type OPIC Photocoupler

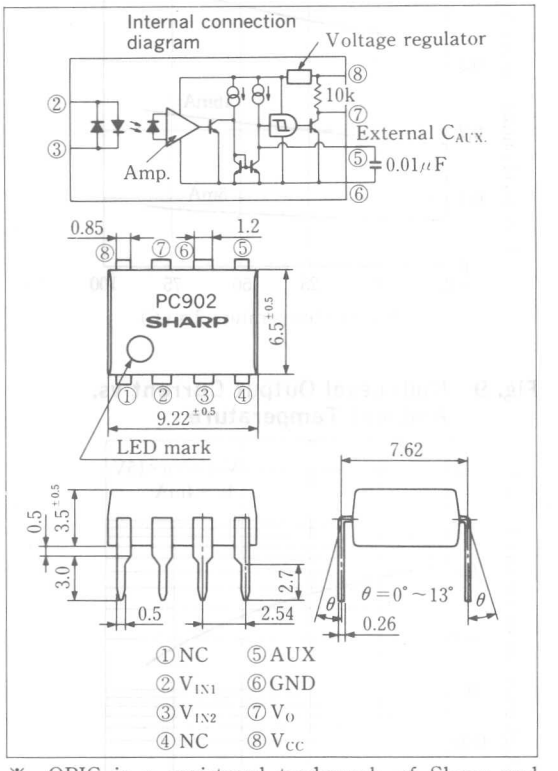
■ Features

1. Capable of forming an integration circuit in conjunction with an external capacitor
2. AC or polarity insensitive input
3. High sensitivity
   (I_{FHL} : MAX. 2mA)
4. High isolation voltage between input and output
   (V_{iso} : 5,000Vrms)
5. Standard dual-in-line package
6. UL recognized, file No. E64380

■ Applications

1. Programmable controllers
2. Telephone sets
3. AC line monitors

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	±20	mA
	*1Peak forward current	I_{FM}	±1	A
	Power dissipation	P	30	mW
Output	Supply voltage	V_{CC}	15	V
	Output voltage	V_O	15	V
	Output current	I_O	16	mA
	Power dissipation	P_O	150	mW
	Total power dissipation	P_{tot}	170	mW
	*2Isolation voltage	V_{iso}	5,000	Vrms
	Operating temperature	T_{opr}	−25~+85	°C
	Storage temperature	T_{stg}	−55~+125	°C
	*3Soldering temperature	T_{sol}	260	°C

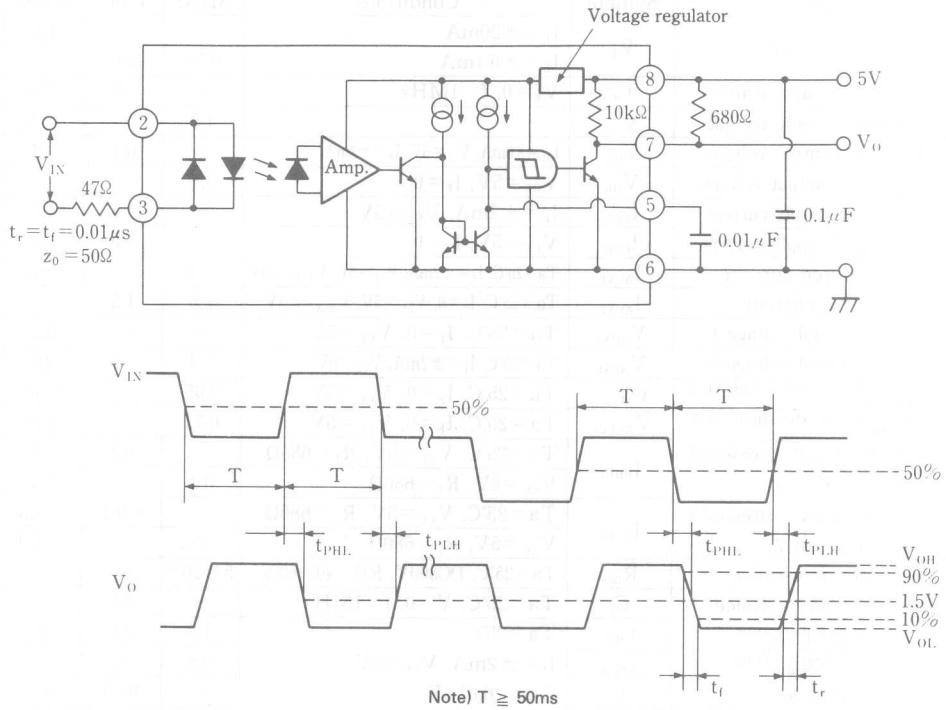
*1 Pulse width≦100μs, Duty ratio=0.001
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=0~+70°C unless specified)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	$I_F=\pm20mA$	—	—	1.5	V
				$I_F=\pm0.1mA$	0.55	0.95	—	V
	Terminal capacitance		C_t	$V_F=0$, f=1MHz	—	30	250	pF
Output	Operating supply voltage		V_{CC}		4.5	—	13.5	V
	Low level output voltage		V_{OL}	$I_{OL}=8.0mA$, $V_{CC}=5V$, $I_F=\pm2mA$	—	0.1	0.4	V
	High level output voltage		V_{OH}	$V_{CC}=5V$, $I_F=0$	3.5	—	—	V
	Low level supply current		I_{CCL}	$I_F=\pm2mA$, $V_{CC}=5V$	—	1.7	4.0	mA
	High level supply current		I_{CCH}	$V_{CC}=5V$, $I_F=0$	—	1.5	3.5	mA
	AUX source current		I_{AUX1}	Ta=25°C, $I_F=\pm2mA$, $V_{CC}=5V$, $V_{AUX}=1.3V$	−2	−3	−5	μA
	AUX sink current		I_{AUX2}	Ta=25°C, $I_F=0$, $V_{CC}=5V$, $V_{AUX}=1.3V$	1.0	1.5	2.5	μA
	AUX terminal voltage 1		V_{AUX1}	Ta=25°C, $I_F=0$, $V_{CC}=5V$	—	—	0.2	V
	AUX terminal voltage 2		V_{AUX2}	Ta=25°C, $I_F=\pm2mA$, $V_{CC}=5V$	2.3	—	2.8	V
	"High→Low" threshold AUX voltage		V_{AUXHL}	Ta=25°C, $I_F=0$, $V_{CC}=5V$	2.05	—	2.55	V
	"Low→High" threshold AUX voltage		V_{AUXLH}	Ta=25°C, $I_F=0$, $V_{CC}=5V$	0.75	—	1.10	V
Transfer characteristics	"High→Low" threshold input current 1		I_{FHL1}	Ta=25°C, $V_{CC}=5V$, $R_L=680\Omega$	—	0.7	1.5	mA
				$V_{CC}=5V$, $R_L=680\Omega$	0.1	—	2.0	mA
	"High→Low" threshold input current 2		I_{FHL2}	Ta=25°C, $V_{CC}=5V$, $R_L=680\Omega$	—	−0.7	−1.5	mA
				$V_{CC}=5V$, $R_L=680\Omega$	−0.1	—	−2.0	mA
	Isolation resistance		R_{ISO}	Ta=25°C, DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance		C_f	Ta=25°C, V=0, f=1MHz	—	0.6	5	pF
	*4 Response time	Propagation time (High→Low)	t_{PHL}	Ta=25°C	4.5	7.0	10	ms
		Propagation time (Low→High)	t_{PLH}	$I_F=\pm2mA$, $V_{CC}=5V$	6.5	10.5	15	ms
		Fall time	t_f	$C_{AUX}=0.01\mu F$	—	0.05	0.5	μs
		Rise time	t_r	$R_L=680\Omega$	—	0.1	0.5	μs
	*5 Instantaneous common mode rejection voltage "Output : high level"		CM_H	Ta=25°C, $I_F=0$, $V_{CM}=600V$ (peak) $V_{O(MIN.)}=2V$, $R_L=680\Omega$, $C_{AUX}=0.01\mu F$	—	2,000	—	V/μs
	*5 Instantaneous common mode rejection voltage "Output : Low level"		CM_L	Ta=25°C, $I_F=\pm2mA$, $V_{CM}=600V$ (Peak) $V_{O(MAX.)}=0.8V$, $R_L=680\Omega$, $C_{AUX}=0.01\mu F$	—	−2,000	—	V/μs

※4 Test Circuit for Response Time



Note) T ≧ 50ms

※5 Test Circuit for Instantaneous Common Mode Rejection Voltage

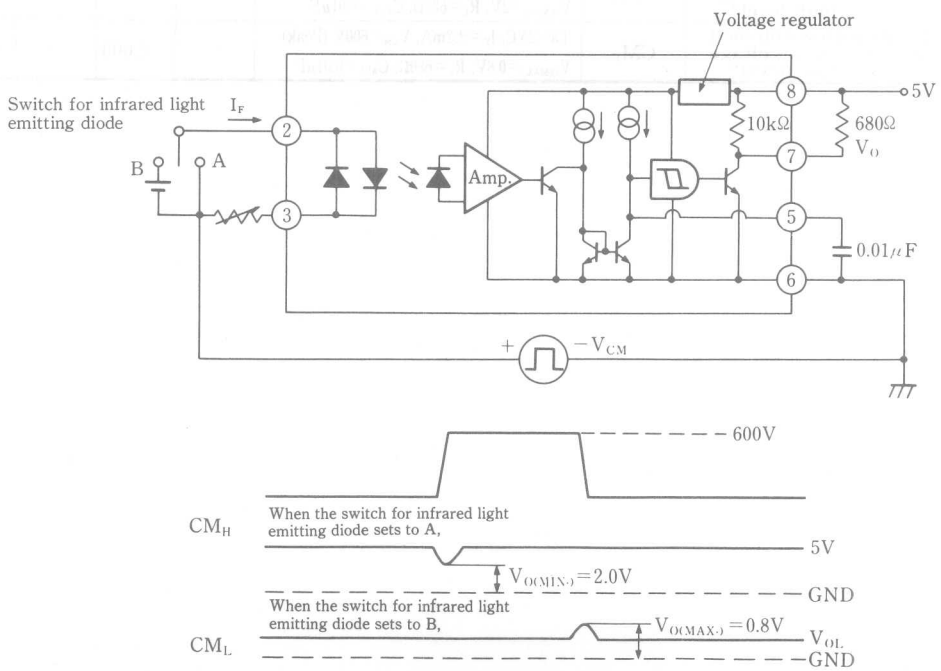


Fig. 1 Forward Current vs. Ambient Temperature

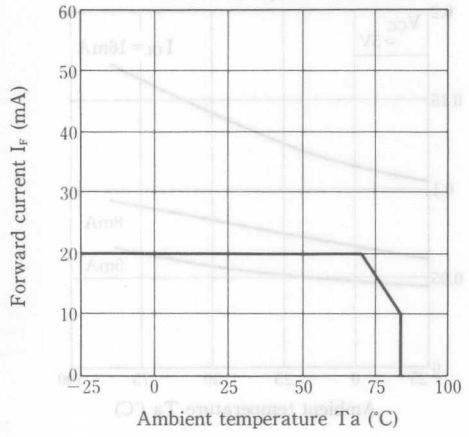


Fig. 2 Output Power Dissipation vs. Ambient Temperature

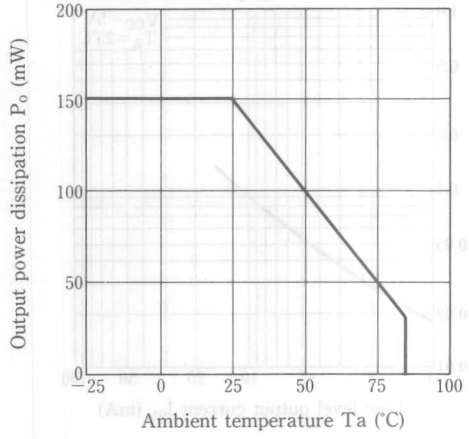


Fig. 3 Total Power Dissipation vs. Ambient Temperature

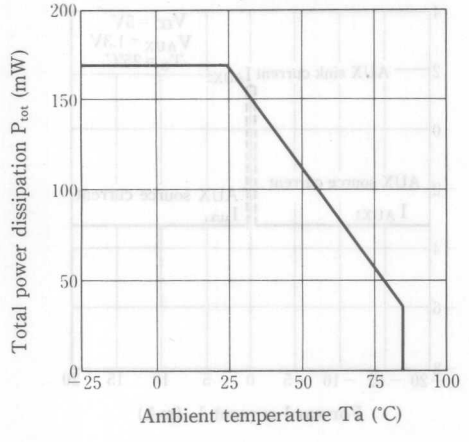


Fig. 4 Forward Current vs. Forward Voltage

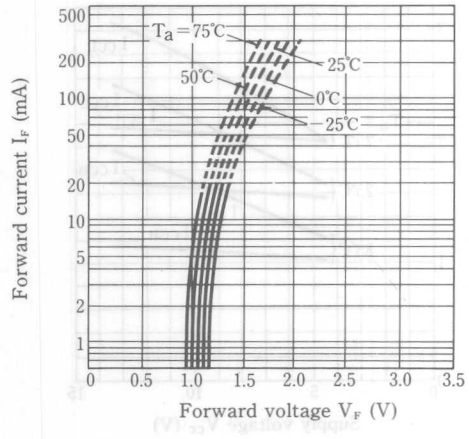
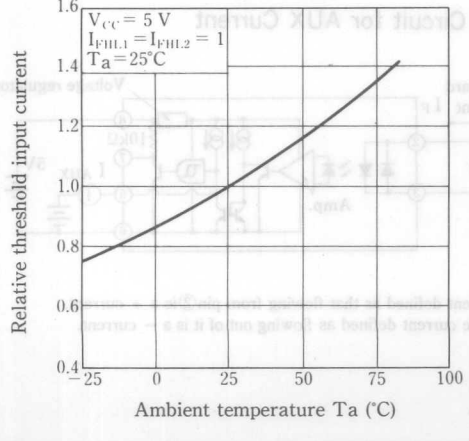
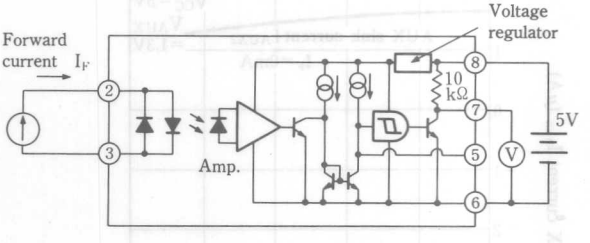


Fig. 5 Relative Threshold Input Current vs. Ambient Temperature



Test Circuit for Threshold Input Current vs. Ambient Temperature



I_{FHL1}, I_{FHL2} represent forward current when output goes from high to low. I_{FHL} is a forward current flowing into pin②while I_{FHL2} is one flowing out of pin②.

6

Fig. 6 Low Level Output Voltage vs. Low Level Output Current

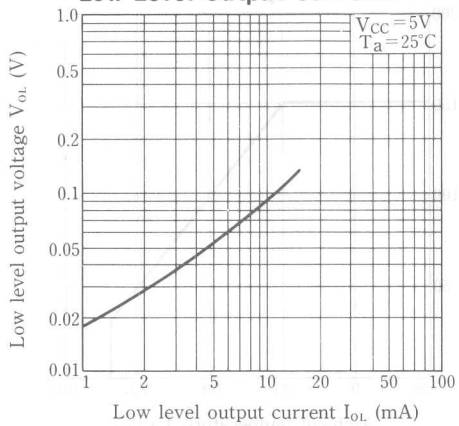


Fig. 7 Low Level Output Voltage vs. Ambient Temperature

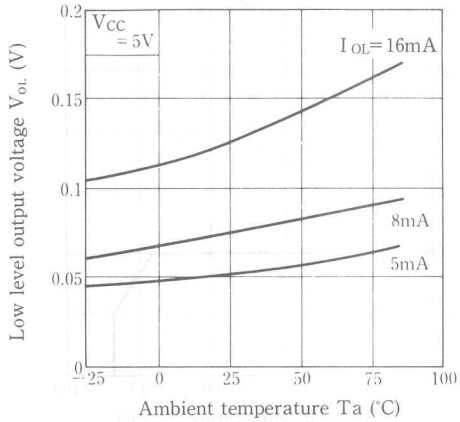


Fig. 8 Supply Current vs. Supply Voltage

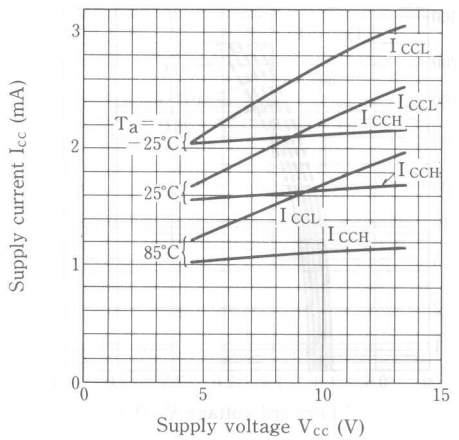


Fig. 9 AUX Current vs. Forward Current

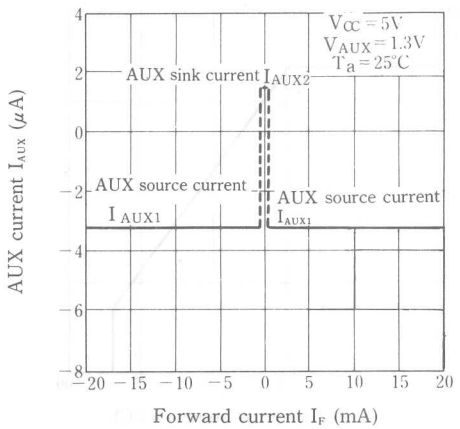
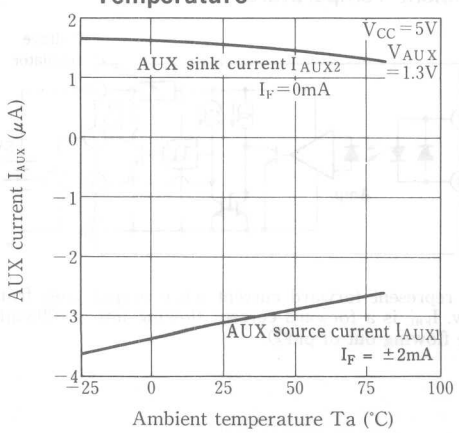
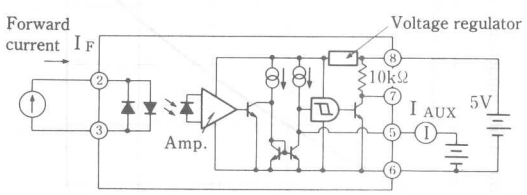


Fig. 10 AUX Current vs. Ambient Temperature



Test Circuit for AUX Current



Current defined as that flowing from pin② is a + current, while current defined as flowing out of it is a − current.

Fig. 11 AUX Terminal Voltage vs. Ambient Temperature

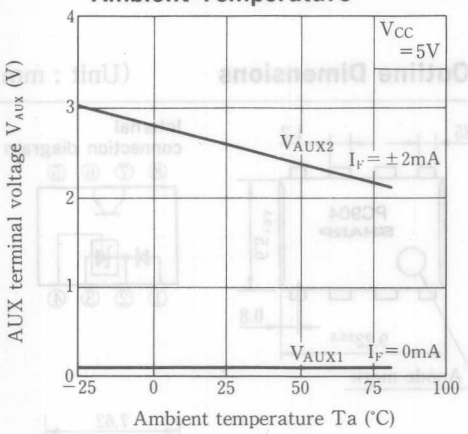


Fig.12 Threshold AUX Voltage vs. Ambient Temperature

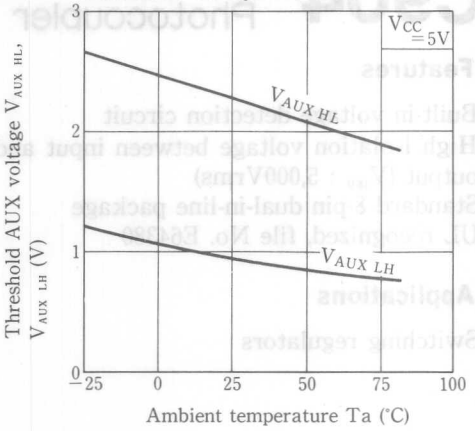


Fig. 13 Propagation Time vs. Forward Current

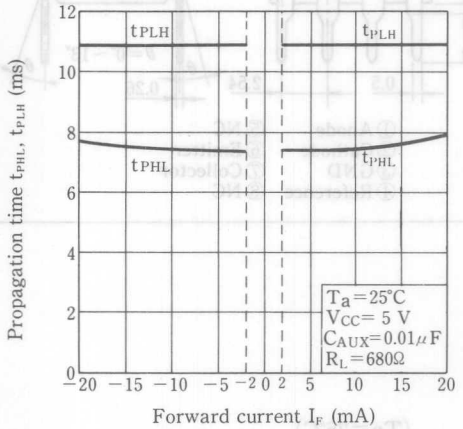
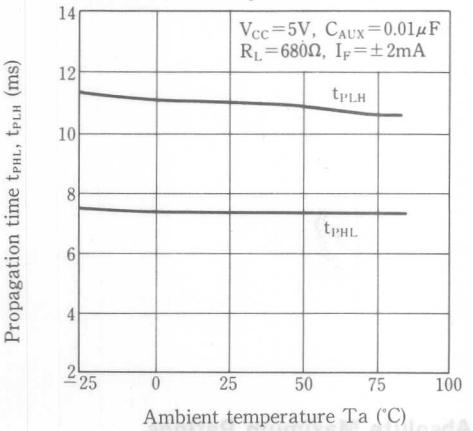
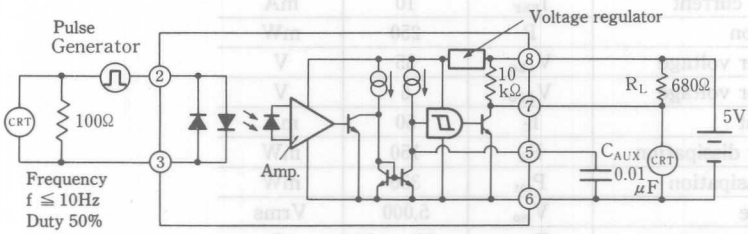


Fig. 14 Propagation Time vs. Ambient Temperature



Test Circuit for Propagation Time



*Characteristics shown here do not include temperature characteristics of the external capacitor C_{AUX}.

6

PC904 Built-in Voltage Detection Circuit Type Photocoupler

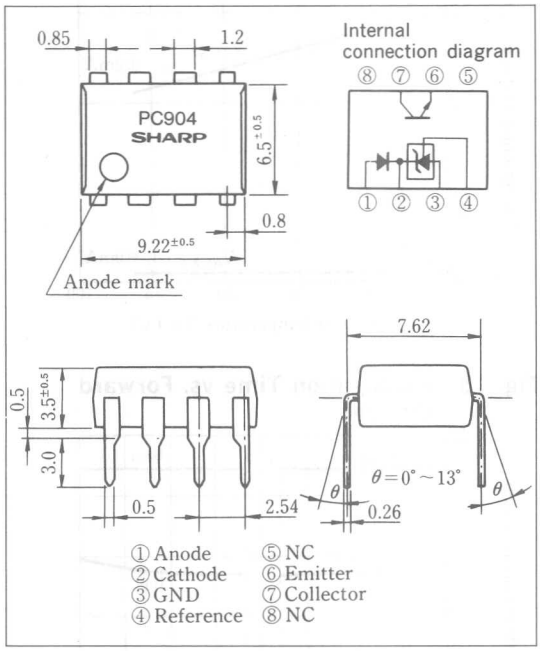
■ Features

1. Built-in voltage detection circuit
2. High isolation voltage between input and output (V_{iso} : 5,000Vrms)
3. Standard 8-pin dual-in-line package
4. UL recognized, file No. E64380

■ Applications

1. Switching regulators

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Anode current	I_A	50	mA
	Anode voltage	V_A	30	V
	Reference input current	I_{REF}	10	mA
	Power dissipation	P	250	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	150	mW
Total power dissipation		P_{tot}	350	mW
*1Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+125	°C
*2Soldering temperature		T_{sol}	260	°C

*1 RH=40～60%, AC for 1 minute
*2 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Fig.
Input	Reference voltage	V_{REF}	$V_K=V_{REF}$, $I_A=10mA$	2.40	2.495	2.60	V	1
	*3 Temperature change in reference voltage	$V_{REF(dev)}$	$V_K=V_{REF}$, $I_A=10mA$, Ta=−25~+85°C	—	8	40	mV	1
	Voltage variation ratio in reference voltage	$\Delta V_{REF}/\Delta V_A$	$I_A=10mA$, $\Delta V_A=30V-V_{REF}$	—	−1.4	−5	mV/V	2
	Reference input current	I_{REF}	$I_A=10mA$, $R_3=10k\Omega$	—	2	10	μA	3
	*4 Temperature change in reference input current	$I_{REF(dev)}$	$I_A=10mA$, $R_3=10k\Omega$, Ta=−25~+85°C	—	0.4	3	μA	3
	Minimum drive current	I_{MIN}	$V_K=V_{REF}$	—	1	2	mA	1
	Off-state anode current	I_{OFF}	$V_A=30V$, $V_{REF}=GND$	—	0.1	2	μA	4
	Anode-cathode forward voltage	V_F	$V_K=V_{REF}$, $I_A=10mA$	—	1.2	1.4	V	1
Output	Collector dark current	I_{CEO}	$V_{CE}=35V$	—	1×10^{-9}	1×10^{-7}	A	5
Transfer characteristics	*5,*6 Current transfer ratio	CTR	$V_K=V_{REF}$, $I_A=5mA$, $V_{CE}=5V$	50	—	600	%	6
	Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_K=V_{REF}$, $I_A=10mA$, $I_C=1mA$	—	0.1	0.2	V	6
	Isolation resistance	R_{ISO}	RH=40~60%, DC500V	5×10^{10}	1×10^{11}	—	Ω	—
	Floating capacitance	C_f	V=0, f=1MHz	—	0.6	1.0	pF	—

*3 $V_{REF(dev)}=V_{REF(MAX.)}-V_{REF(MIN.)}$
*4 $I_{REF(dev)}=I_{REF(MAX.)}-I_{REF(MIN.)}$
*5 $CTR=I_C/I_A\times100(\%)$
*6 Classification table of cuffent transfer ratio is shown below.

Model No.	Rank mark	CTR (%)
PC904A	A	50~150
PC904B	B	100~300
PC904C	C	250~600
PC904	A, B or C	50~600

■ Test Circuit

Fig. 1

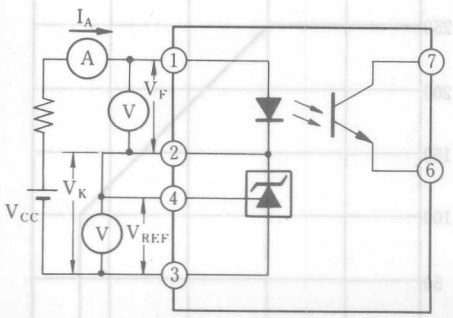
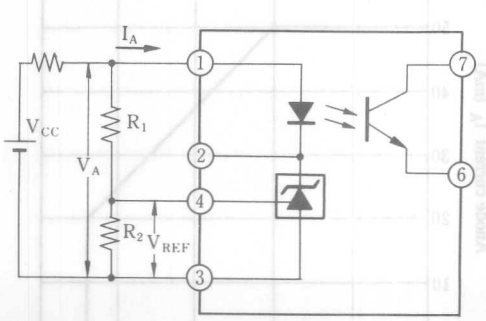


Fig. 2



6

Fig. 3

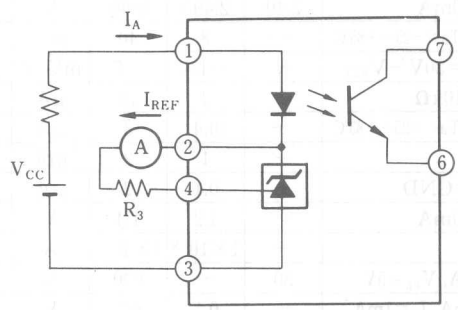


Fig. 4

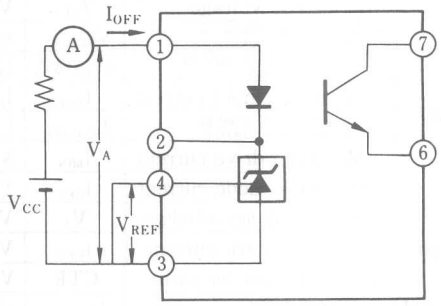


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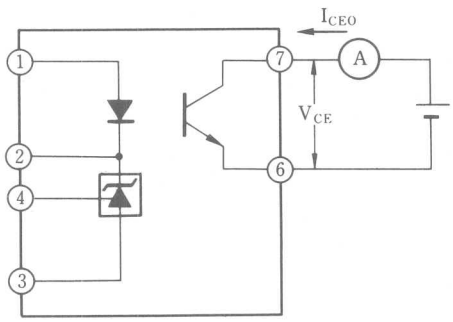


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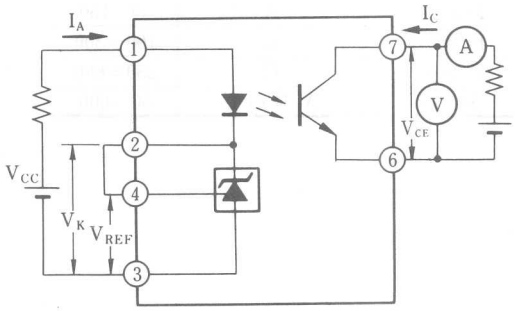


Fig. 7 Anode Current vs. Ambient Temperature

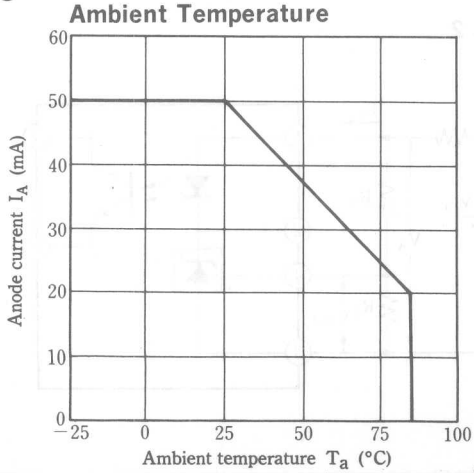


Fig. 8 Input Power Dissipation vs. Ambient Temperature

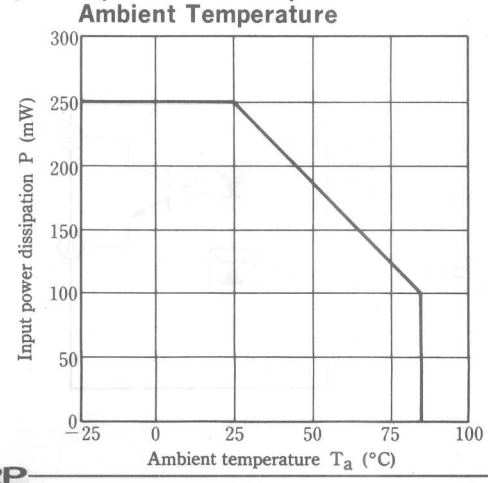


Fig. 9 Collector Power Dissipation vs. Ambient Temperature

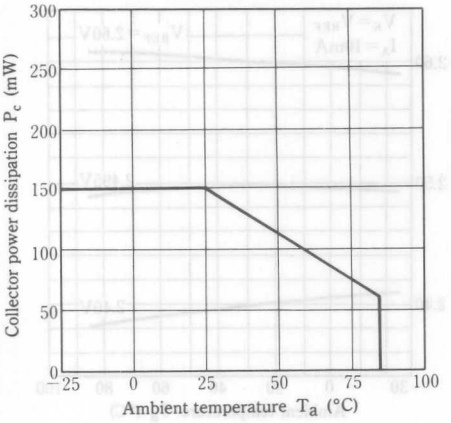


Fig. 10 Total Power Dissipation vs. Ambient Temperature

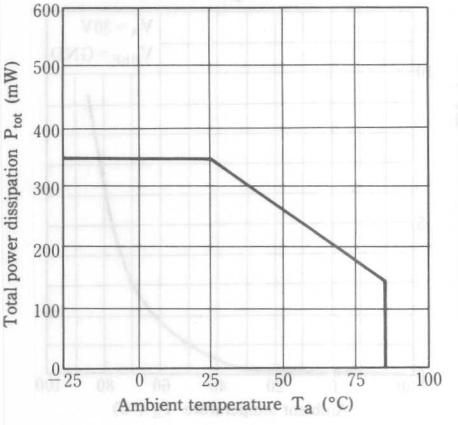


Fig. 11 Relative Current Transfer Ratio vs. Ambient Temperature

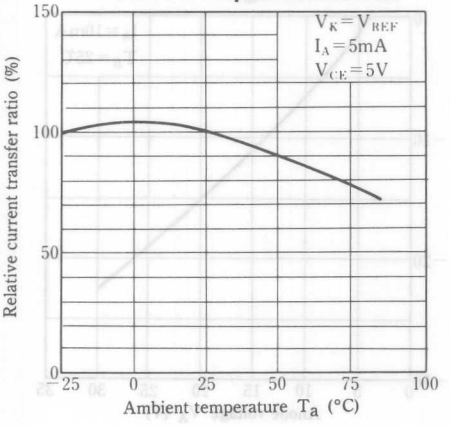


Fig. 12 Collector Dark Current vs. Ambient Temperature

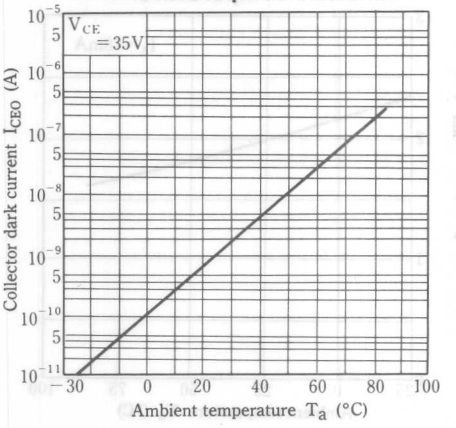


Fig. 13 Anode Current vs. Reference Voltage

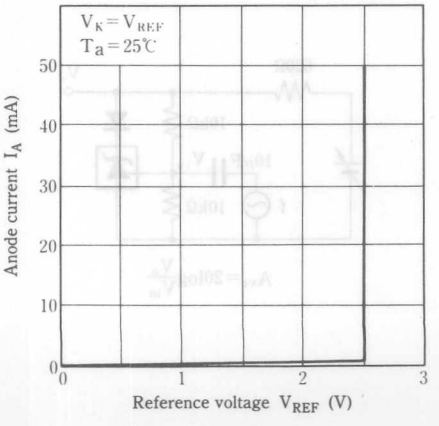
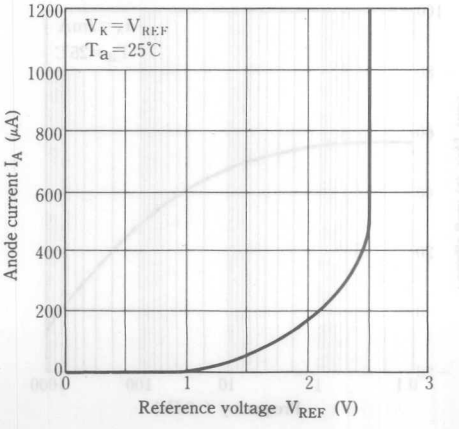


Fig. 14 Anode Current vs. Reference Voltage



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Fig. 15 Off-state Anode Current vs. Ambient Temperature

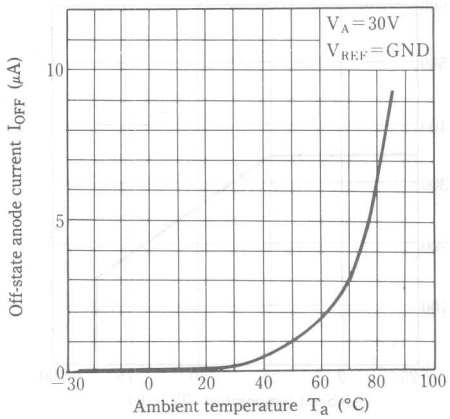


Fig. 16 Reference Voltage vs. Ambient Temperature

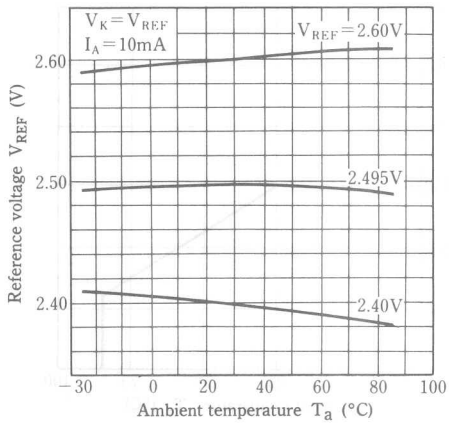


Fig. 17 Reference Input Current vs. Ambient Temperature

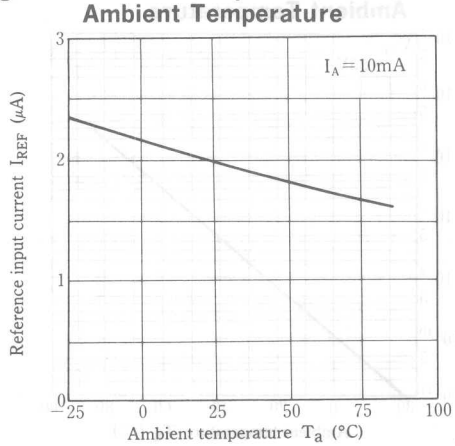


Fig. 18 Reference Voltage Change vs. Anode Voltage

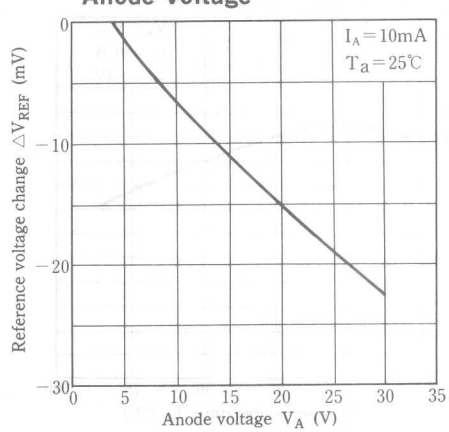
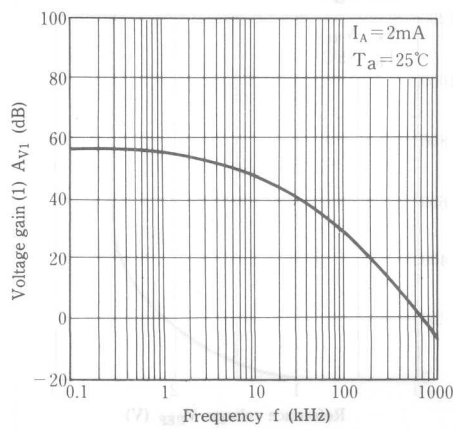


Fig. 19 Voltage Gain (1) vs. Frequency



Test Circuit for Voltage Gain (1) vs. Frequency

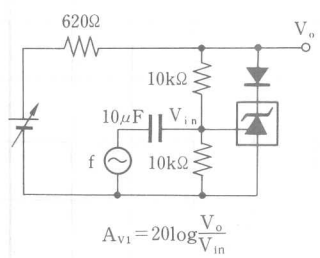
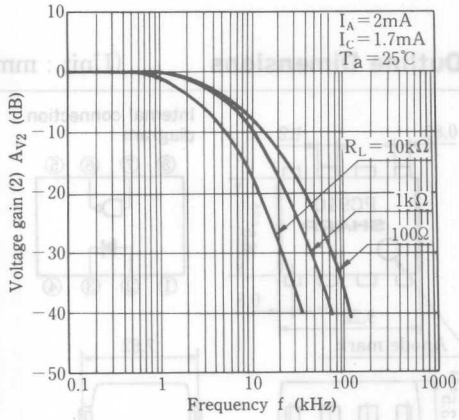


Fig. 20 Voltage Gain (2) vs. Frequency



Test Circuit for Voltage Gain (2) vs. Frequency

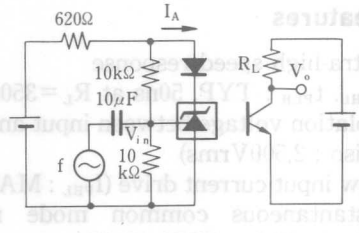
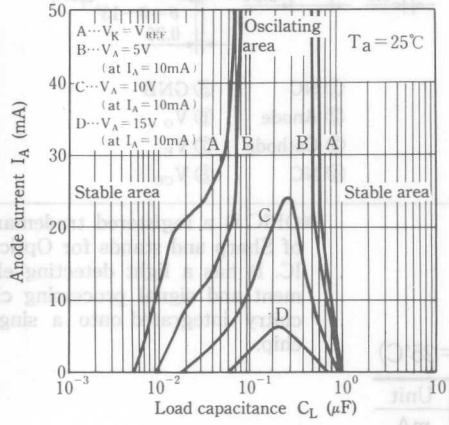
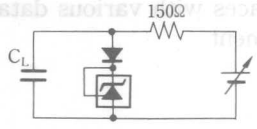


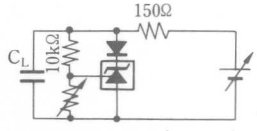
Fig. 21 Anode Current vs. Load Capacitance



Test Circuit for Anode Current vs. Load Capacitance



Test circuit I (A)



Test circuit II (B, C, D)

Fig. 22 Collector-emitter Saturation Voltage vs. Ambient Temperature

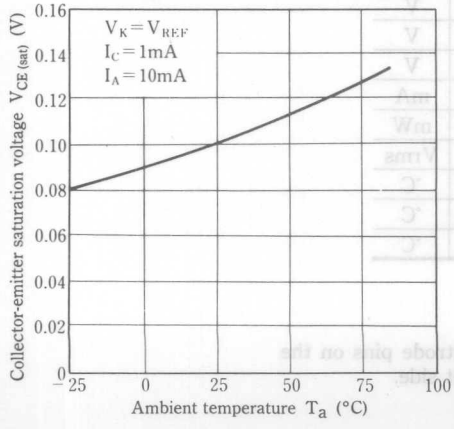
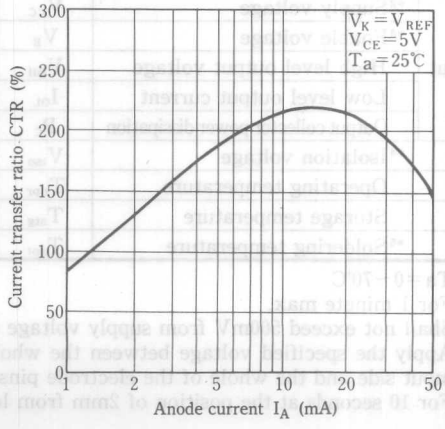


Fig. 23 Current Transfer Ratio vs. Anode Current



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PC910 Ultra-high Speed Response OPIC Photocoupler

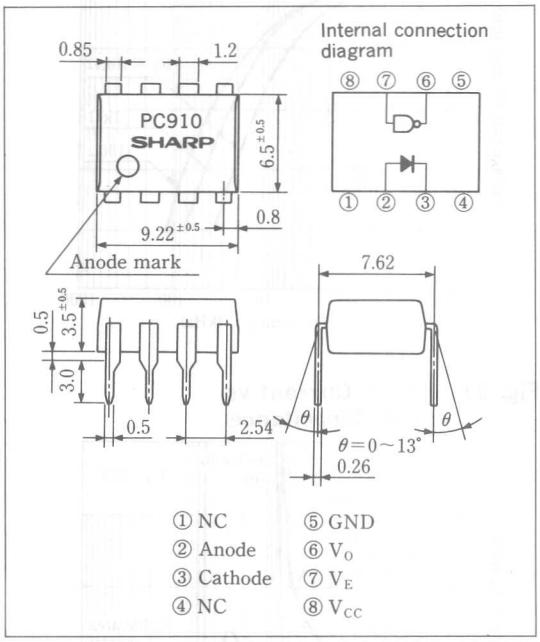
■ Features

1. Ultra-high speed response
(t_{PHL}, t_{PLH} : TYP. 50ns at R_L=350Ω)
2. Isolation voltage between input and output
(Viso : 2,500Vrms)
3. Low input current drive (I_{FHL} : MAX. 5mA)
4. Instantaneous common mode rejection voltage CM_H : TYP. 500V/μs
5. TTL and LSTTL compatible output
6. UL recognized, file No. E64380

■ Applications

1. High speed interfaces for computer peripherals and microcomputer systems
2. High speed line receivers
3. Interfaces with various data transmission equipment

■ Dutline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	*1Forward current	I_F	20	mA
	Reverse voltage	V_R	5	V
	Power dissipation	P	40	mW
Output	*2Supply voltage	V_{CC}	7	V
	*3Enable voltage	V_E	5.5	V
	High level output voltage	V_{OH}	7	V
	Low level output current	I_{OL}	50	mA
	Output collector power dissipation	P_C	85	mW
*4Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	0~+70	°C
Storage temperature		T_{stg}	−55~+125	°C
*5Soldering temperature		T_{sol}	260	°C

*1 Ta=0~70°C
*2 For 1 minute max.
*3 Shall not exceed 500mV from supply voltage (V_{CC}).
*4 Apply the specified voltage between the whole of the electrode pins on the input side and the whole of the electrode pins on the output side.
*5 For 10 seconds at the position of 2mm from lead base

■ Electro-optical Characteristics

(Ta=0～+70°C unless otherwise specified)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	Ta=25°C, I_F=10mA	—	1.6	1.9	V
	Reverse current		I_R	Ta=25°C, V_R=5V	—	—	10	μA
	Terminal capacitance		C_t	Ta=25°C, V=0, f=1MHz	—	60	150	pF
Output	High level output current		I_{OH}	V_{CC}=V_O=5.5V, V_E=2.0V, I_F=250μA	—	2	250	μA
	Low level output voltage		V_{OL}	V_{CC}=5.5V, V_E=2.0V, I_F=5mA, I_{OL}=13mA	—	0.4	0.6	V
	High level enable current		I_{EH}	V_{CC}=5.5V, V_E=2.0V	—	−0.8	−1.8	mA
	Low level enable current		I_{EL}	V_{CC}=5.5V, V_E=0.5V	—	−1.2	−2.0	mA
	High level supply current		I_{CCH}	V_{CC}=5.5V, I_F=0, V_E=0.5V	—	7	15	mA
	Low level supply current		I_{CCL}	V_{CC}=5.5V, I_F=10mA, V_E=0.5V	—	13	18	mA
Transfer characteristics	"High→Low" threshold input current		I_{FHL}	V_{CC}=5V, V_E=2.0V, V_O=0.8V, R_L=350Ω	—	2.5	5	mA
	Isolation resistance		R_{ISO}	Ta=25°C, DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance		C_f	Ta=25°C, V=0, f=1MHz	—	0.6	5	pF
	Current transfer ratio		CTR	Ta=25°C, V_{CC}=5V, I_F=5mA, R_L=100Ω	260	700	—	%
	Response characteristics	"High→Low" propagation delay time	t_{PHL}	Ta=25°C, V_{CC}=5V, Fig. 1 R_L=350Ω, C_L=15pF I_F=7.5mA	—	50	120	ns
		"Low→High" propagation delay time	t_{PLH}		—	50	120	ns
		Rise time, Fall time	t_r, t_f		—	30	60	ns
		"High→Low" enable propagation delay time	t_{EHL}	Ta=25°C, V_{CC}=5V, Fig. 2 R_L=350Ω, C_L=15pF	—	15	50	ns
		"Low→High" enable propagation delay time	t_{ELH}	I_F=7.5mA, V_{EH}=3V V_{EL}=0.5V	—	65	100	ns
	CMR	Instantaneous common mode rejection voltage "Output : high level"	CM_H	Ta=25°C, V_{CC}=5V, V_{CM}=10$V_{(peak)}$ R_L=350Ω, I_F=0, $V_{O(MIN.)}$=2V, Fig. 3	100	500	—	V/μs
		Instantaneous common mode rejection voltage "Output : Low level"	CM_L	Ta=25°C, V_{CC}=5V, V_{CM}=10$V_{(peak)}$ R_L=350Ω, I_F=5mA, $V_{O(MAX.)}$=0.8V, Fig. 3	−100	−500	—	V/μs

All typical values: at Ta=25°C, V_{CC}=5V

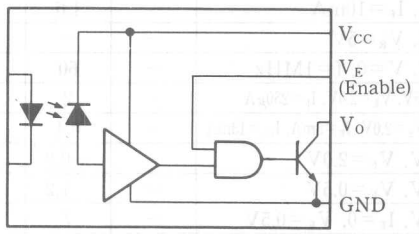
■ Recommended Operation Conditions

Parameter	Symbol	MIN.	MAX.	Unit
Low level input current	I_{FL}	0	250	μA
High level input current	I_{FH}	7	15	mA
High level enable voltage	V_{EH}	2.0	V_{CC}	V
Low level enable voltage	V_{EL}	0	0.8	V
Supply voltage	V_{CC}	4.5	5.5	V
Fanout (TTL load)	N	—	8	—
Operating temperature	T_{opr}	0	70	°C

1. When the enable input is in high level state, external pull-up is unnecessary.
2. Connect a by-pass ceramic capacitor (0.01～0.1μF) between V_{CC} and GND at the position within 1cm from pin.

6

Circuit Block Diagram

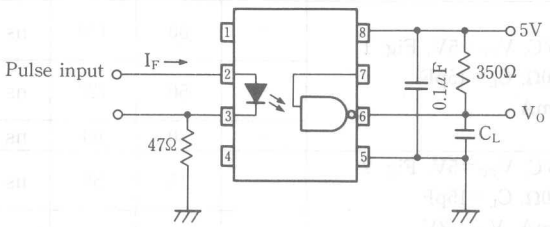


Truth Table

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H

L : Logic (0)
H : Logic (1)

Fig. 1 Test Circuit for t_{PHL}, t_{PLH}, t_r and t_f



* C_L includes the probe and wiring capacitance.

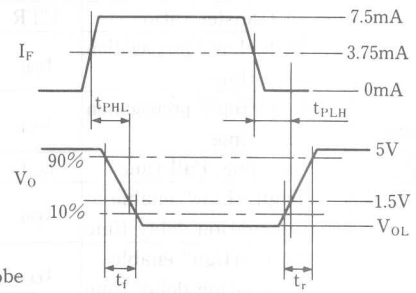
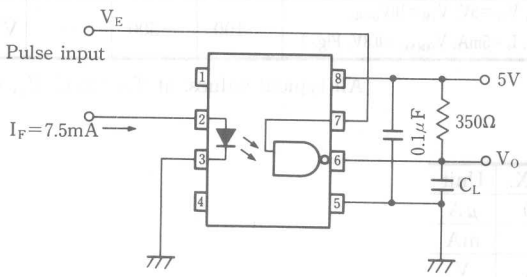


Fig. 2 Test Circuit for t_{EHL} and t_{ELH}



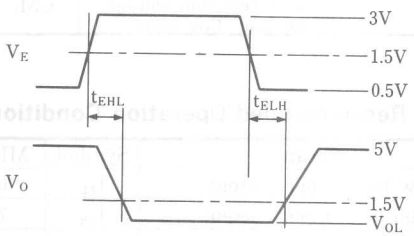
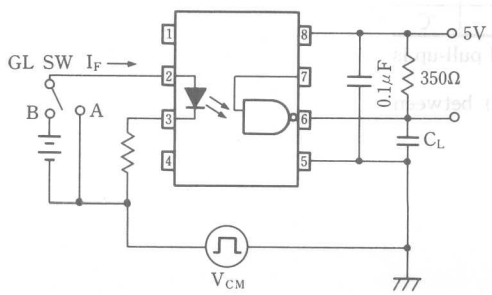


Fig. 3 Test Circuit for CM_H and CM_L



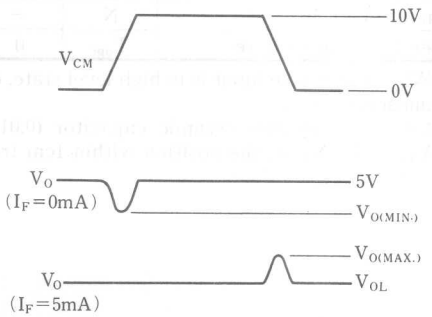


Fig. 4 Collector Power Dissipation vs. Ambient Temperature

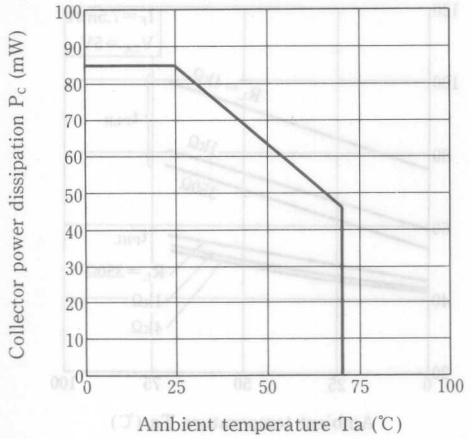


Fig. 5 Forward Current vs. Forward Voltage

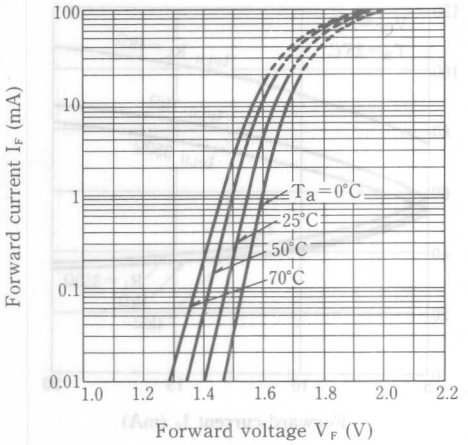


Fig. 6 High Level Output Current vs. Ambient Temperature

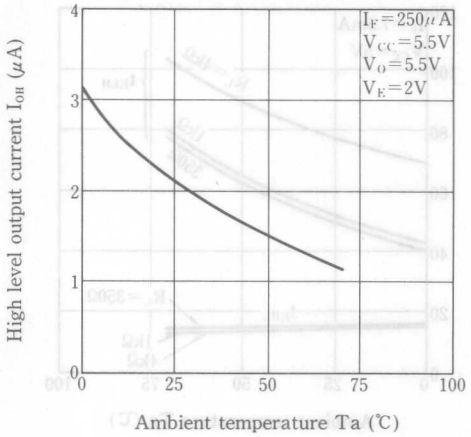


Fig. 7 Low Level Output Voltage vs. Ambient Temperature

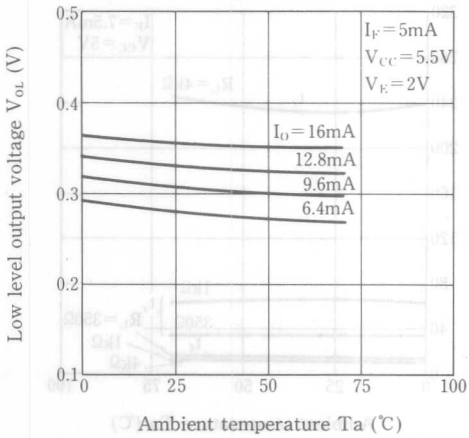


Fig. 8 Output Voltage vs. Forward Current

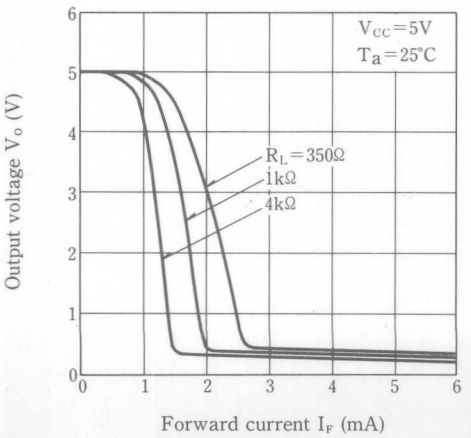
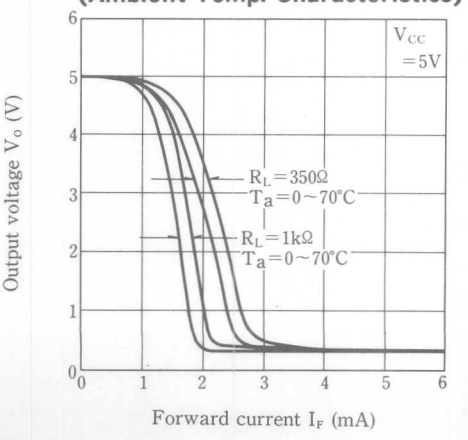


Fig. 9 Output Voltage vs. Forward Current (Ambient Temp. Characteristics)



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Fig. 10 Propagation Time vs. Forward Current

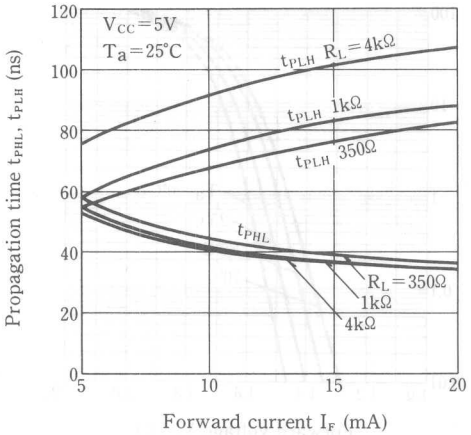


Fig. 11 Propagation Time vs. Ambient Temperature

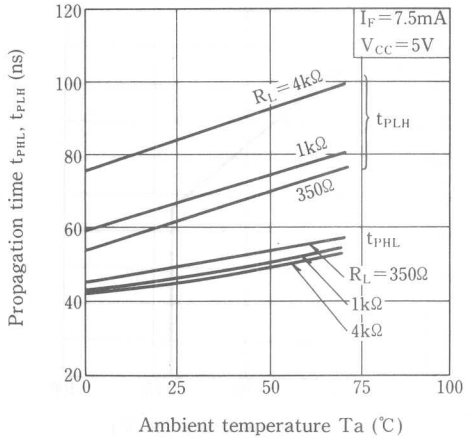


Fig. 12 Rise Time, Fall Time vs. Ambient Temperature

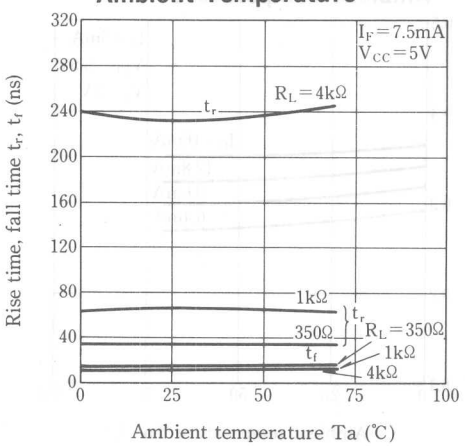
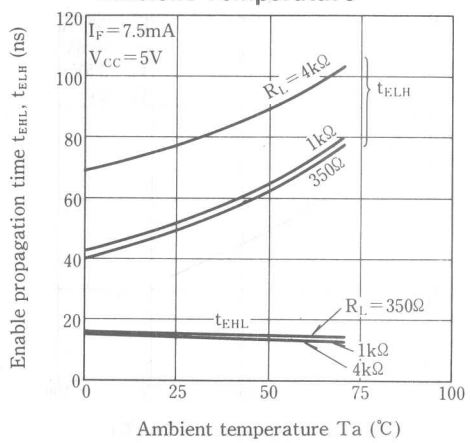


Fig. 13 Enable Propagation Time vs. Ambient Temperature



PC915 Wide Band Linear Output Type OPIC Photocoupler

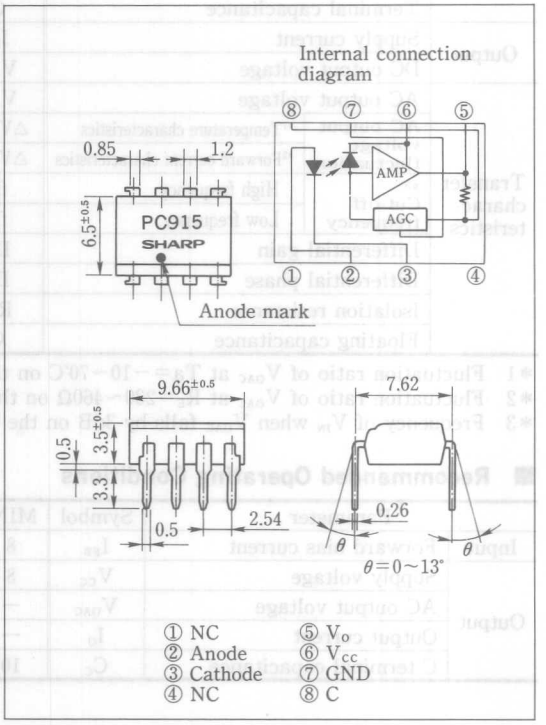
■ Features

1. Wide band linear output type (Frequency band width: TYP. 10Hz ~8MHz)
2. Fluctuation-free stable output (Output fluctuation: TYP. ±3% at Ta=−10~+70°C)
3. High linearity (Differential gain: TYP. ±3%)
4. High isolation voltage (V_{iso}: 5,000Vrms)

■ Applications

1. Video signal insulation in TV
2. Insulation amplifier in measuring instrument and FA equipment

■ Outline Dimensions



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	25	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	45	mW
Output	Supply voltage	V_{CC}	13	V
	Output power dissipation	P_O	250	mW
	Output current	I_O	−1.0~+0.5	mA
*1Isolation voltage		V_{iso}	5,000	V_{rms}
Operating temperature		T_{opr}	−25~+85	°C
Storage temperature		T_{stg}	−55~+125	°C
*2Soldering temperature		T_{sol}	260	°C

*1 RH=40~60%, AC for 1 minute
*2 For 10 seconds

6

■ Electro-optical Characteristics

(Unless otherwise spcified, Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Fig.
Input	Forward voltage		V_F	I_F=10mA	—	1.6	1.8	V	1
	Reverse voltage		I_R	V_R=5V	—	—	10	μA	—
	Terminal capacitance		C_t	V=0, f=1MHz	—	60	250	pF	—
Output	Supply current		I_{CC}	I_F=10mA	—	9	16	mA	1
	DC output voltage		V_{ODC}	I_F=10mA	4	6	8	V	1
Transfer characteristics	AC output voltage		V_{OAC}	R_E=230Ω	0.8	1.0	1.2	V_{p-p}	2
	AC output voltage fluctuation	*1Temperature characteristics	ΔV_{OAC-1}	R_E=230Ω, Ta=10~70°C	—	±3	—	%	2
		*2Forward current characteristics	ΔV_{OAC-2}	R_E=230~460Ω	—	±3	—	%	2
	*3 Cut-off frequency	High frequency	f_{CH}	R_E=230Ω	6	8	—	MHz	2
		Low frequency	f_{CL}	R_E=230Ω	—	10	20	Hz	2
	Differential gain		DG		—	±3	—	%	3
	Differential phase		DP		—	±3	—	deg.	3
	Isolation resistance		R_{ISO}	DC500V, RH=40~60%	5×10^{10}	1×10^{11}	—	Ω	—
	Floating capacitance		C_f	V=0, f=1MHz	—	0.6	5	pF	—

*1 Fluctuation ratio of V_{OAC} at Ta=−10~70°C on the basis of that of V_{OAC} at Ta=25°C
*2 Fluctuation ratio of V_{OAC} at R_E=230~460Ω on the basis of V_{OAC} at R_E=230Ω
*3 Frequency of V_{IN} when V_{OAC} falls by 3dB on the basis of V_{OAC} when frequency of V_{IN} in Fig. 2 is 100KHz

■ Recommended Operating Conditions

(Ta=−10~70°C)

Parameter		Symbol	MIN.	MAX.	Unit
Input	Forward bias current	I_{FB}	8	15	mA
Output	Supply voltage	V_{CC}	8	13	V
	AC output voltage	V_{OAC}	—	2	V_{p-p}
	Output current	I_O	—	$^{+0.2}_{-0.6}$	mA
	C terminal capacitance	C_C	10	—	μF

■ Test Circuit

Fig. 1

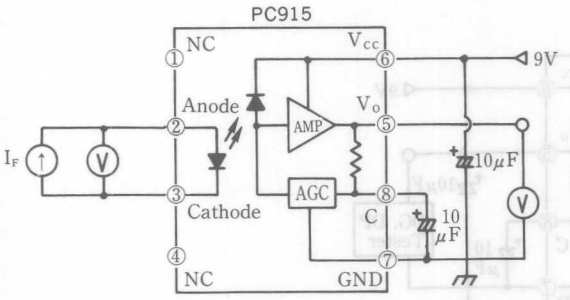
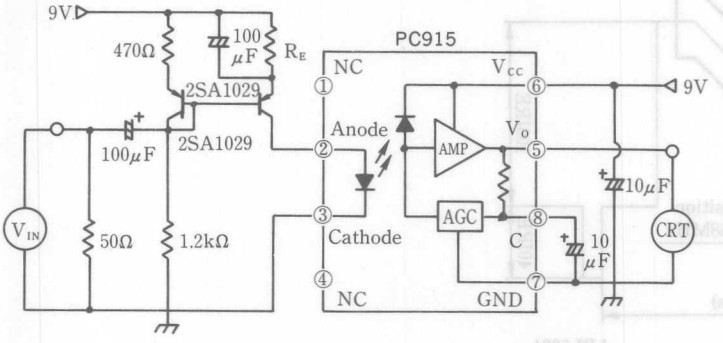
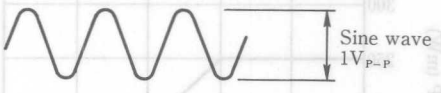


Fig. 2



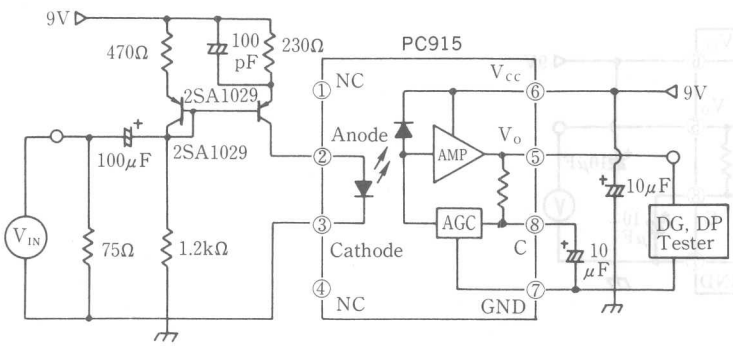
V_{IN} Waveform



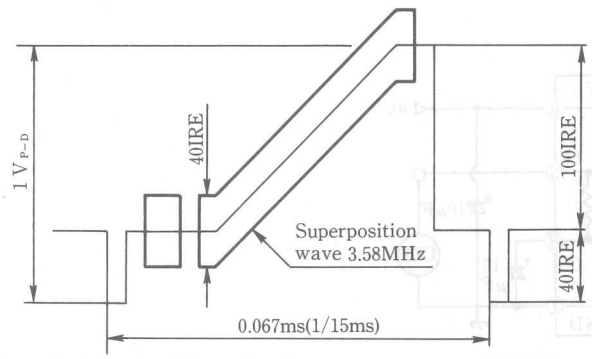
(Frequency) 15kHz at measuring V_{OAC}, ΔV_{OAC-1} and ΔV_{OAC-2} and shall be swept at measuring f_{CH} and f_{CL}.

6

Fig. 3



V_{IN} Waveform



※ APL (Average Picture Level) APL50%
※ IRE (International Radio Engineers)
1IRE=7.14mV (NTSC System)

Fig. 4 Forward Current vs. Ambient Temperature

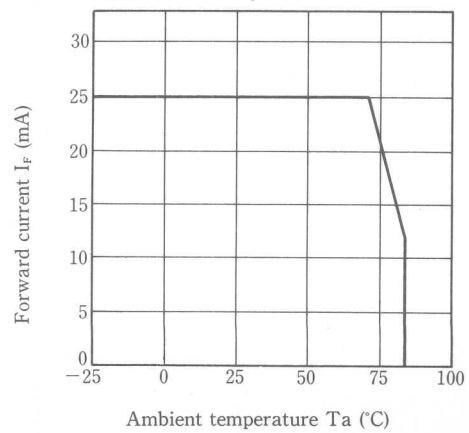
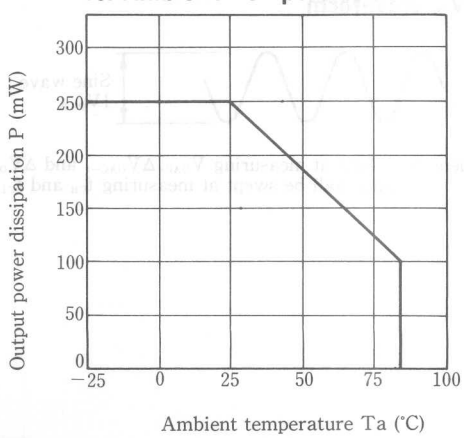


Fig. 5 Output Power Dissipation vs. Ambient Temperature



PC917/PC918

High Speed, High CMR OPIC Photocoupler

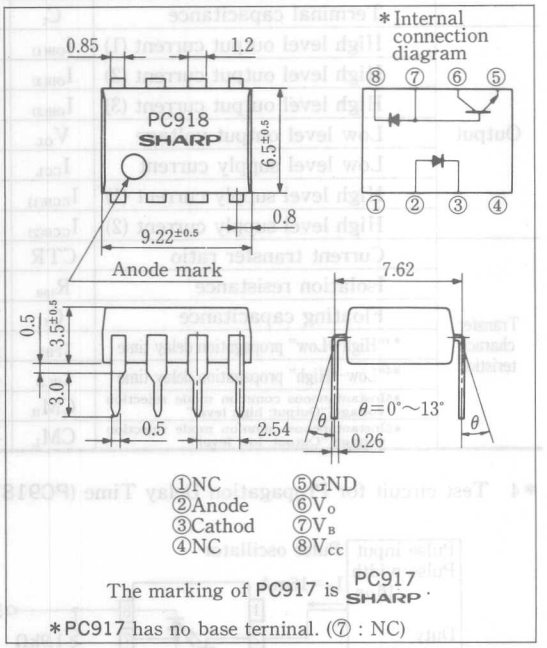
■ Features

1. High speed response
   t_{PHL}, t_{PLH}: TYP. 0.3μs at
   R_L=1.9kΩ
2. High instantaneous common mode rejection voltage
   CM_H: TYP. 1kV/μs
3. Standard dual-in-line package
4. UL recognized, file NO. E64380

■ Applications

1. Computers, measuring instruments, controllers
2. High speed line receivers high speed logic
3. Switching regulators
4. Signal transmission between circuits of different potentials and impedances

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

6

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	25	mA
	Reverse voltage	V_R	5	V
	Power dissipation	P	45	mW
Output	Supply voltage	V_{CC}	−0.5~+15	V
	Output voltage	V_O	−0.5~+15	V
	*1Emitter-base voltage	V_{EBO}	5	V
	Output current	I_O	8	mA
	Power dissipation	P_O	100	mW
*2Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	−55~+100	°C
Storage temperature		T_{stg}	−55~+125	°C
*3Soldering temperature		T_{sol}	260	°C

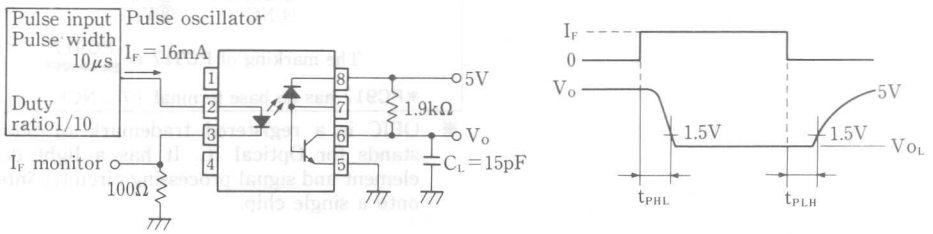
*1 Voltage between pin 5 and pin 7 (applies to PC918)
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

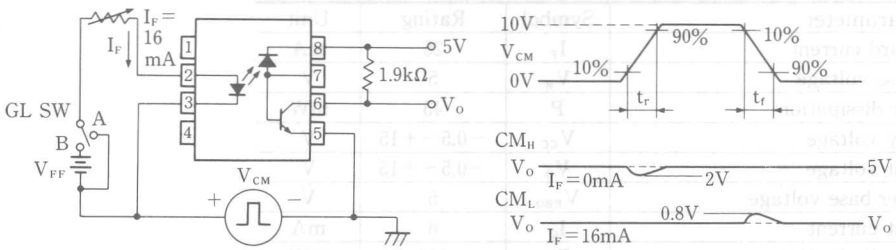
(Ta=0~+70°C unless otherwise specified)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	Ta=25°C, I_F=16mA	—	1.7	1.95	V
	Reverse current	I_R	Ta=25°C, V_R=5V	—	—	10	μA
	Terminal capacitance	C_t	Ta=25°C, V_F=0, f=1MHz	—	60	250	pF
Output	High level output current (1)	$I_{OH(1)}$	Ta=25°C, I_F=0, V_{CC}=V_O=5.5V	—	3	500	nA
	High level output current (2)	$I_{OH(2)}$	Ta=25°C, I_F=0, V_{CC}=V_O=15V	—	—	1	μA
	High level output current (3)	$I_{OH(3)}$	I_F=0, V_{CC}=V_O=15V	—	—	50	μA
	Low level output voltage	V_{OL}	I_F=16mA, I_O=2.4mA, V_{CC}=15V	—	—	0.4	V
	Low level supply current	I_{CCL}	I_F=16mA, V_O=open, V_{CC}=15V	—	200	—	μA
	High level supply current (1)	$I_{CCH(1)}$	Ta=25°C, I_F=0, V_O=open V_{CC}=15V	—	0.02	1	μA
	High level supply current (2)	$I_{CCH(2)}$	I_F=0, V_O=open, V_{CC}=15V	—	—	2	μA
Transfer characteristics	Current transfer ratio	CTR	Ta=25°C, I_F=16mA, V_O=0.4V, V_{CC}=4.5V	19	—	—	%
	Isolation resistance	R_{ISO}	Ta=25°C, DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	Ta=25°C, V=0, f=1MHz	—	0.6	1	pF
	*4"High→Low" propagation delay time	t_{PHL}	Ta=25°C, R_L=1.9kΩ I_F=16mA, V_{CC}=5V	—	0.3	0.8	μs
	*4"Low→High" propagation delay time	t_{PLH}	Ta=25°C, R_L=1.9kΩ I_F=16mA, V_{CC}=5V	—	0.3	1.2	μs
	*5Instantaneous common mode rejection voltage "Output: high level"	CM_H	Ta=25°C, I_F=0, R_L=1.9kΩ V_{CM}=10Vp-p, V_{CC}=5V	—	1,000	—	V/μs
	*5Instantaneous common mode rejection voltage "Output: low level"	CM_L	Ta=25°C, I_F=16mA, R_L=1.9kΩ, V_{CM}=10Vp-p, V_{CC}=5V	—	−1,000	—	V/μs

*4 Test circuit for Propagation Delay Time (PC918)



*5 Test circuit for Instantaneous Common Mode Rejection Voltage (PC918)



When the switch for infrared light emitting diode sets to A,

When the switch for infrared light emitting diode sets to B,

Fig. 1 Forward Current vs. Ambient Temperature

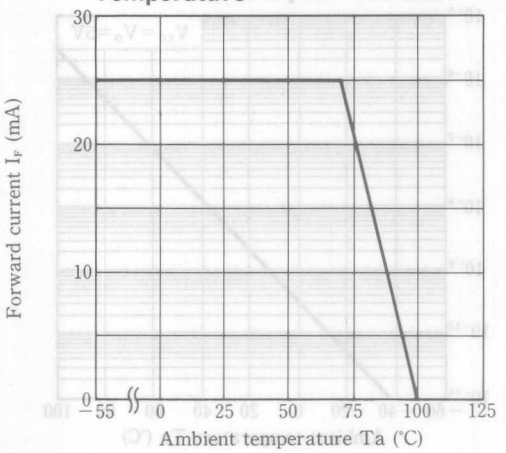


Fig. 2 Power Dissipation vs. Ambient Temperature

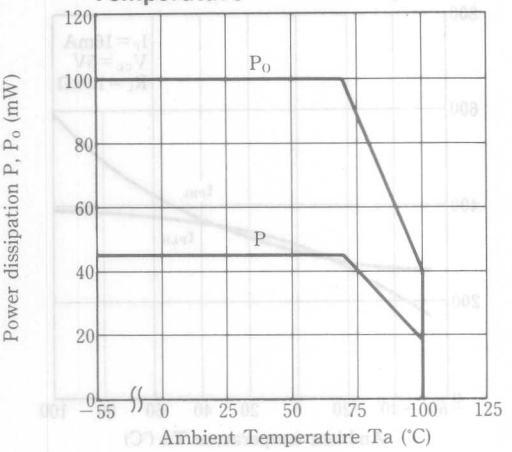


Fig. 3 Forward current vs. Forward Voltage

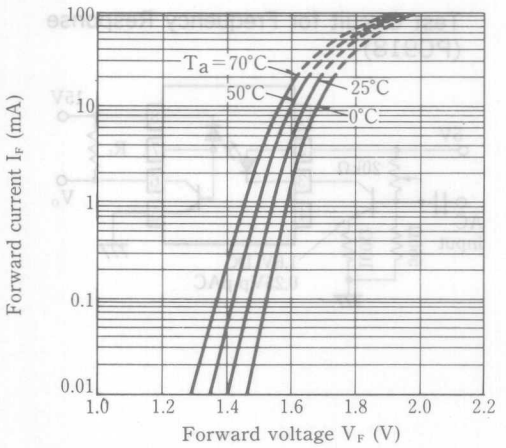


Fig. 4 Output current vs. Output voltage

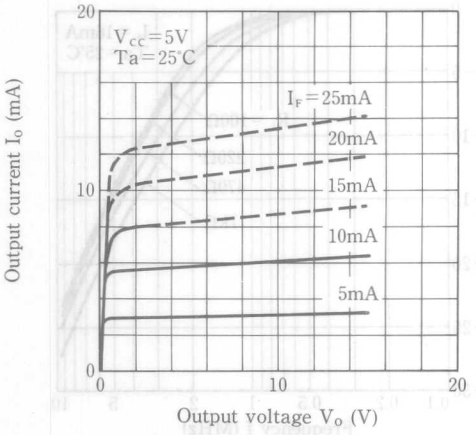


Fig. 5 Relative Current Transfer Ratio vs. Forward Current

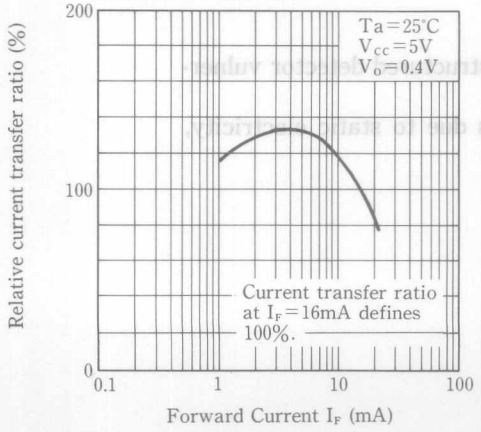
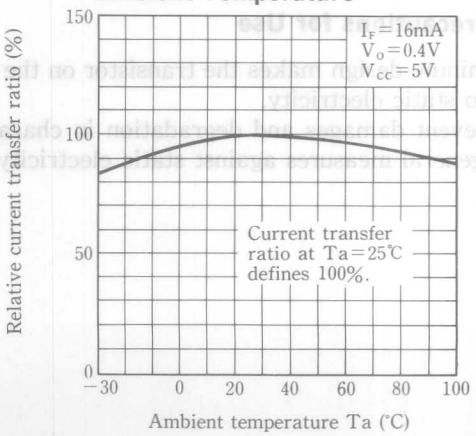


Fig. 6 Relative current Transfer Ratio vs. Ambient Temperature



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Fig. 7 Prapagation Delay Time vs. Ambient Temperature

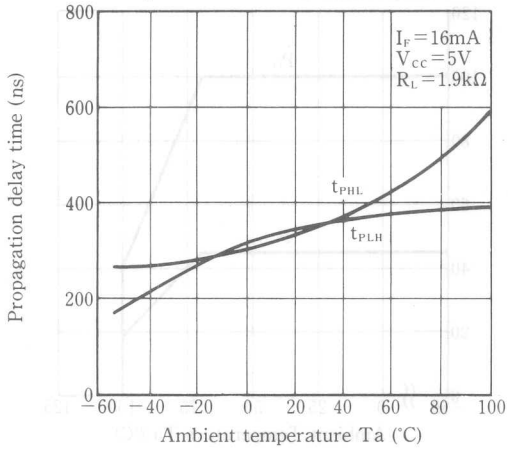


Fig. 8 High Level Output Current vs. Ambient Temperature

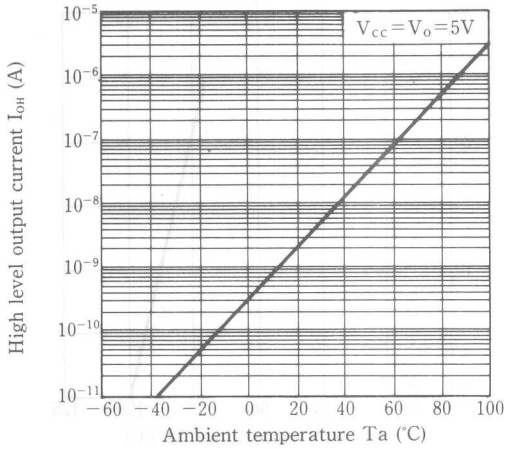
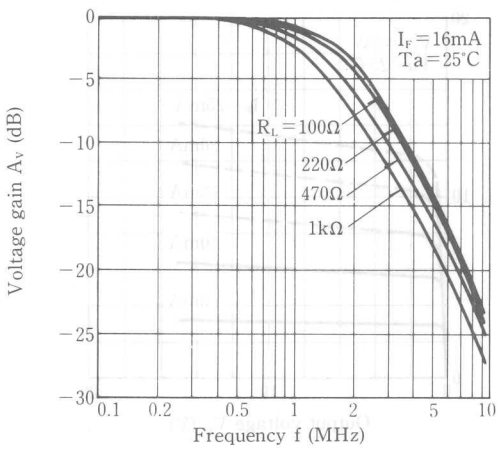
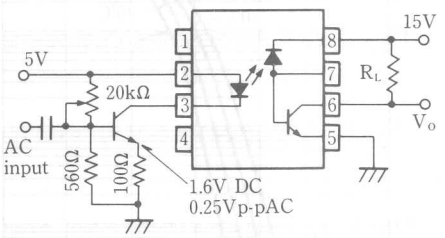


Fig. 9 Frequency Response



Test Circuit for Frequency Response (PC918)



■ Precautions for Use

The minute design makes the transistor on the bipolar structured detector vulnerable to static electricity.
To prevent damages and degradation in characteristics due to static electricity, take general measures against static electricity.

PC920 Power OPIC Photocoupler

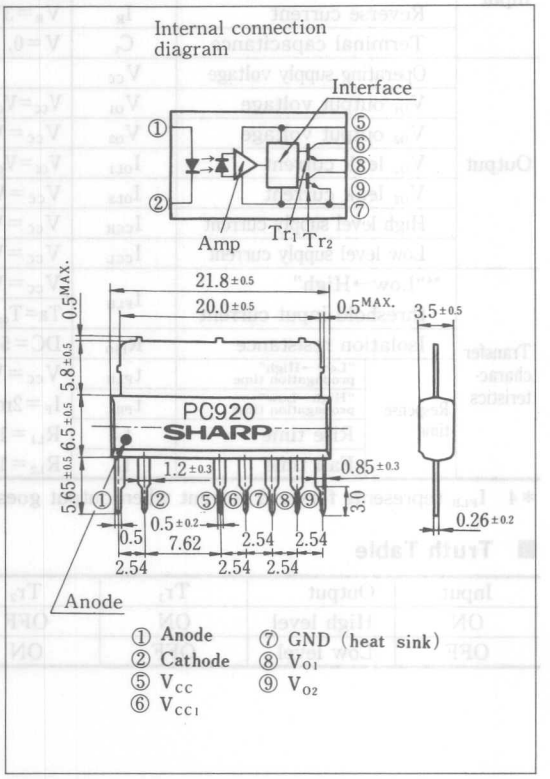
■ Features

1. High power
   (I_{O1} : MAX. −0.8A (DC))
   (I_{O2} : MAX. 1.6A (Pulse))
2. Low input current drive
   (I_{FLH} : MAX. 2mA at Ta = T_{opr})
3. Operating supply voltage V_{CC} : 5.4~15V
4. Compact single-in-line package (With heat sink)
5. UL recognized, file No. E64380

■ Applications

1. Inverter controlled air conditioners

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	70	mW
Output	Supply voltage	V_{CC}	16	V
	V_{O1} output current	I_{O1}	−0.8	A
	*1V_{O2} output current	I_{O2P}	1.6	A
Total power dissipation		P_{tot}	1,200	mW
*2Isolation voltage		V_{iso}	1,500	Vrms
Operating temperature		T_{opr}	−20~+80	°C
Storage temperature		T_{stg}	−55~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦10μs, Duty ratio=0.02
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C unless specified)

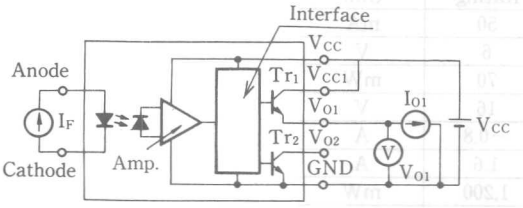
Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=2mA	—	1.1	1.4	V
				I_F=0.1mA	0.6	0.95	—	
	Reverse current		I_R	V_R=3V	—	—	10	μA
	Terminal capacitance		C_t	V=0, f=1kHz	—	30	80	pF
Output	Operating supply voltage		V_{CC}		5.4	6.0	15	V
	V_{O1} output voltage		V_{O1}	V_{CC}=V_{CC1}=6V, I_{O1}=−0.3A, I_F=2mA	4.5	5.2	—	V
	V_{O2} output voltage		V_{O2}	V_{CC}=V_{CC1}=6V, I_{O2P}=1A, I_F=0	—	0.3	2.0	V
	V_{O1} leak current		I_{OL1}	V_{CC}=V_{CC1}=6V, V_{O1}=GND, I_F=0	—	—	200	μA
	V_{O2} leak current		I_{OL2}	V_{CC}=V_{CC1}=V_{O2}=6V, I_F=2mA	—	—	200	μA
	High level supply current		I_{CCH}	V_{CC}=V_{CC1}=6V, I_F=2mA	—	5	10	mA
	Low level supply current		I_{CCL}	V_{CC}=V_{CC1}=6V, I_F=0	—	12	20	mA
Transfer characteristics	*4"Low→High" threshold input current		I_{FLH}	V_{CC}=V_{CC1}=6V, R_{L1}=15Ω	—	0.5	1.0	mA
				Ta=T_{opr}, V_{CC}=V_{CC1}=6V, R_{L1}=15Ω	0.1	—	2.0	mA
	Isolation resistance		R_{ISO}	DC=500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Response time	"Low→High" propagation time	t_{PLH}	V_{CC}=V_{CC1}=6V	—	3	10	μs
		"High→Low" propagation time	t_{PHL}	I_F=2mA	—	3	10	
		Rise time	t_r	R_{L1}=15Ω	—	0.2	2	
		Fall time	t_f	R_{L2}=18Ω	—	0.2	2	

*4 I_{FLH} represents forward current when output goes from "low" to "high".

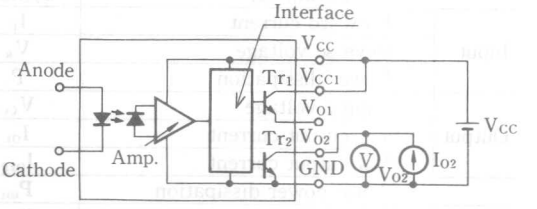
■ Truth Table

Input	Output	Tr_1	Tr_2
ON	High level	ON	OFF
OFF	Low level	OFF	ON

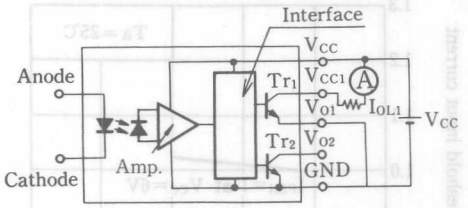
Test Circuit for V_{O1}



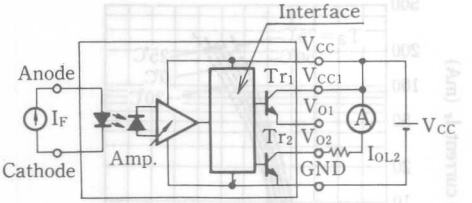
Test Circuit for V_{O2}



Test Circuit for I_{OL1}



Test Circuit for I_{OL2}



Test Circuit for Response Time

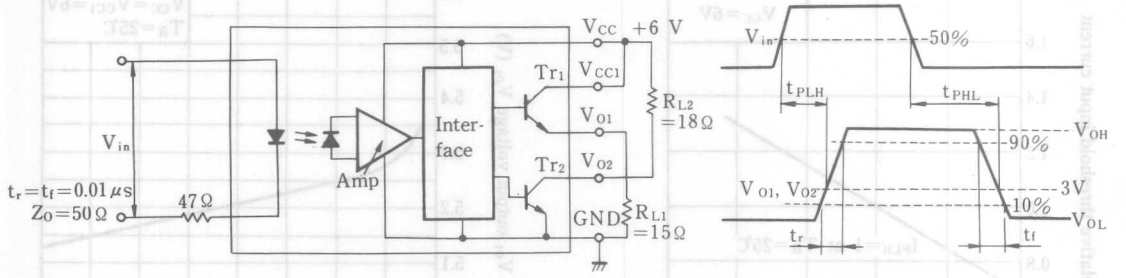


Fig. 1 Forward Current vs. Ambient Temperature

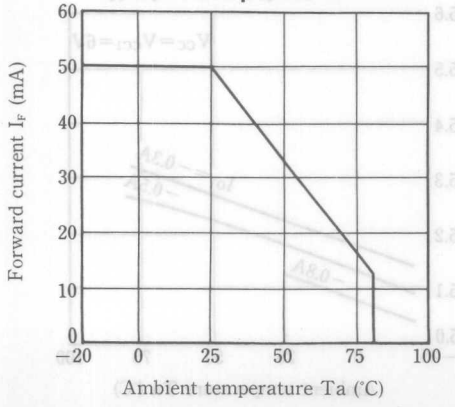
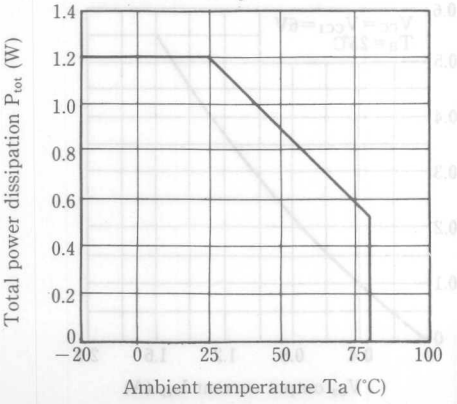


Fig. 2 Total Power Dissipation vs. Ambient Temperfture



6

Fig. 3 Forward Current vs. Forward Voltage

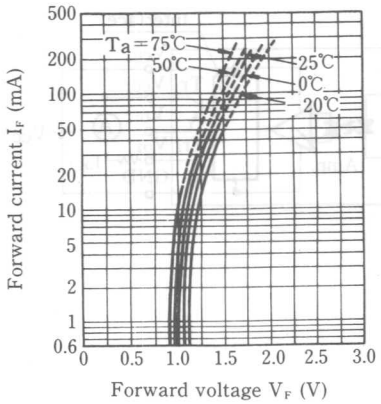


Fig. 4 Relative Threshold Input Current vs. Supply Voltage

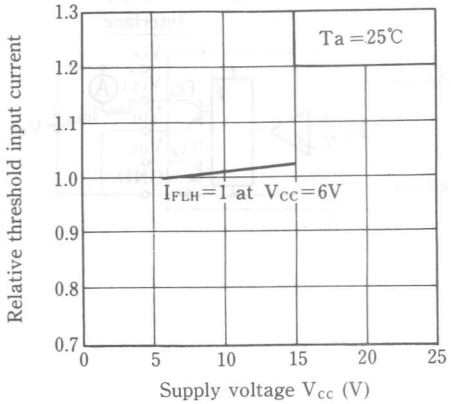


Fig. 5 Relative Threshold Input Current vs. Ambient Temperature

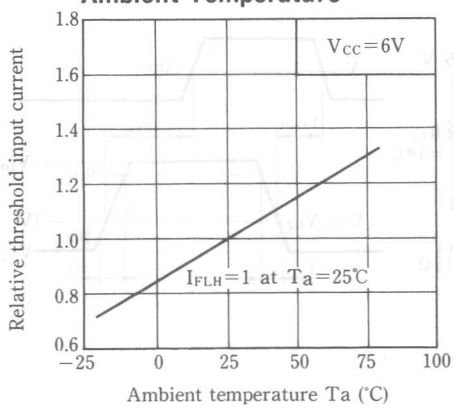


Fig. 6 Output Voltage vs. Output Current (Tr_1)

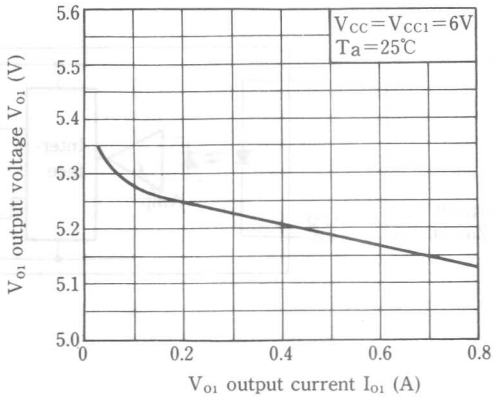


Fig. 7 Output Voltage vs. Output Current (Tr_2)

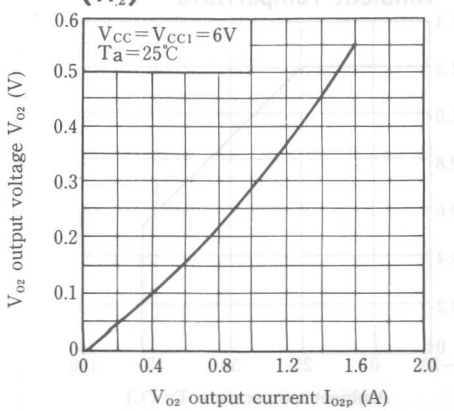


Fig. 8 Output Voltage vs. Ambient Temperature (Tr_1)

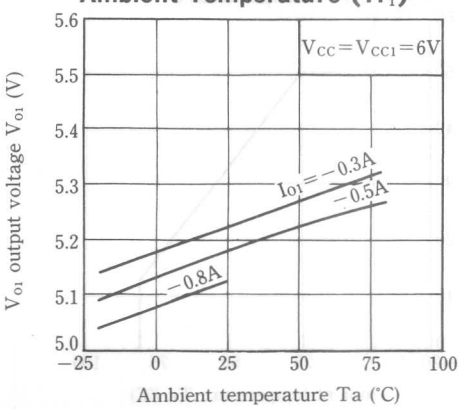


Fig. 9 Output Voltage vs. Ambient Temperature (Tr_2)

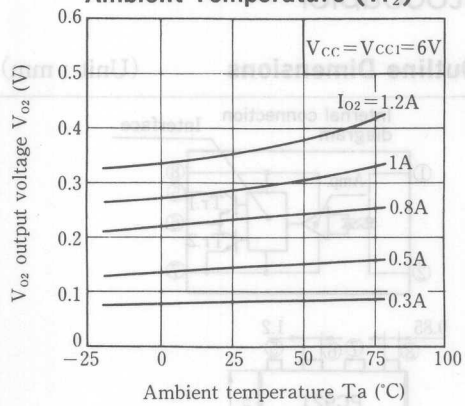


Fig. 10 Supply Current vs. Supply Voltage

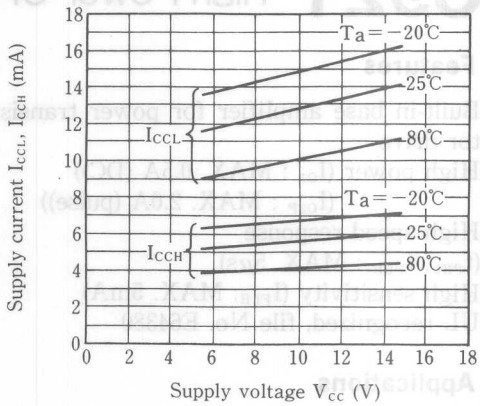


Fig. 11 Propagation Time vs. Forward Current

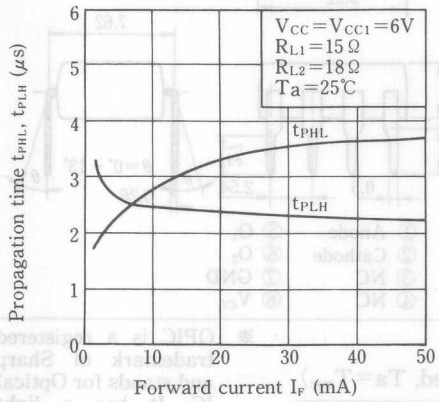
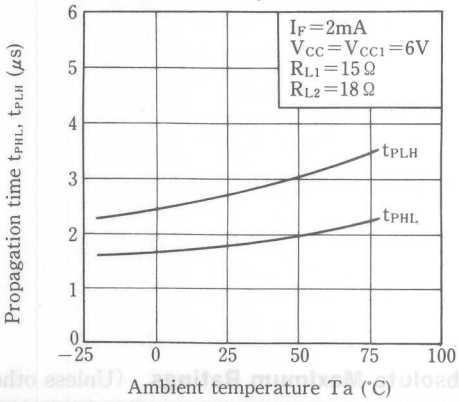
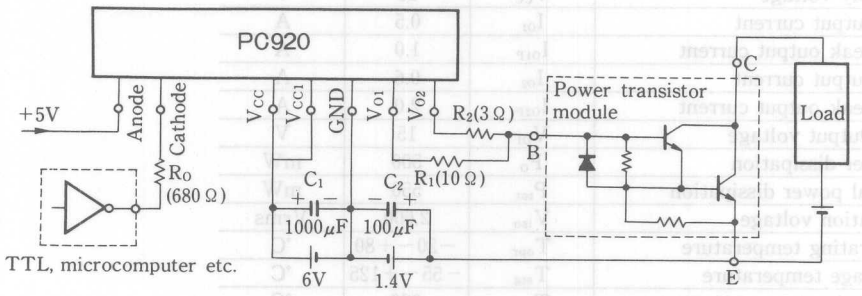


Fig. 12 Propagation Time vs. Ambient Temperature



■ Application Circuit Example



6

PC921 High Power OPIC Photocoupler

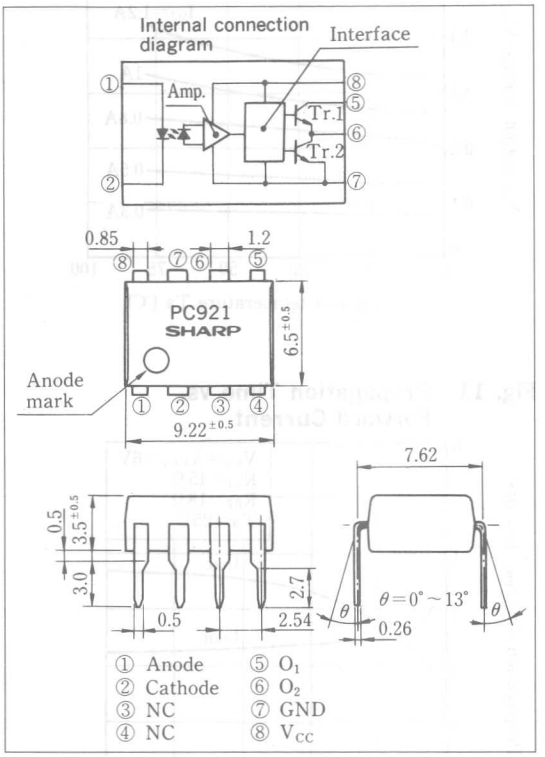
■ Features

1. Built-in base amplifier for power transistor drive
2. High power (I_{O1} : MAX. 0.5A (DC))
   (I_{O2P} : MAX. 2.0A (pulse))
3. High speed response
   (t_{PHL}, t_{PLH} : MAX. 5μs)
4. High sensitivity (I_{FLH}: MAX. 5mA)
5. UL recognized, file No. E64380

■ Applications

1. Inverter controlled air conditioners
2. Low capacitance general purpose inverter

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Unless otherwise specified, Ta=T_{opr})

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	25	mA
	*1Reverse voltage	V_R	6	V
Output	Supply voltage	V_{CC}	15	V
	O_1 output current	I_{O1}	0.5	A
	*2O_1 peak output current	I_{O1P}	1.0	A
	O_2 output current	I_{O2}	0.6	A
	*2O_2 peak output current	I_{O2P}	2.0	A
	O_1 Output voltage	V_{O1}	15	V
	Power dissipation	P_O	500	mW
Total power dissipation		P_{tot}	550	mW
*3Isolation voltage		V_{iso}	2,000	Vrms
Operating temperature		T_{opr}	−20~+80	°C
Storage temperature		T_{stg}	−55~+125	°C
*4Soldering temperature		T_{sol}	260	°C

*1 Ta=25°C
*2 Pulse width≦5μs, Duty ratio=0.01
*3 RH=40~60%, AC for 1 minute, Ta=25°C
*4 For 10 seconds

■ Electro-optical Characteristics

(Unless otherwise specified Ta = T_{opr})

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Fig.
Input	Forward voltage		V_{F1}	Ta = 25°C, I_F = 5mA	—	1.1	1.4	V	—
			V_{F2}	Ta = 25°C, I_F = 0.2mA	0.6	0.9	—	V	—
	Reverse current		I_R	Ta = 25°C, V_F = 3V	—	—	10	μA	—
	Terminal capacitance		C_t	Ta = 25°C, V = 0, f = 1kHz	—	30	250	pF	—
Output	Operating supply voltage		V_{CC}	———	5.4	—	13	V	—
	O_1 low level output voltage		V_{O1L}	V_{CC} = 6V, I_{O1} = 0.4A, R_{L2} = 10Ω, I_F = 5mA	—	0.2	0.4	V	1
	O_2 high level output voltage		V_{O2H}	V_{CC} = 6V, I_{O2} = −0.4A, I_F = 5mA	4.5	5.0	—	V	2
	O_2 low level output voltage		V_{O2L}	V_{CC} = 6V, I_{O2} = 0.5A, I_F = 0	—	0.2	0.4	V	2
	O_1 leak current		I_{O1L}	V_{CC} = 13V, I_F = 0	—	—	200	μA	3
	O_2 leak current		I_{O2L}	V_{CC} = 13V, I_F = 5mA	—	—	200	μA	4
	High level supply current		I_{CCH}	Ta = 25°C, V_{CC} = 6V, I_F = 5mA	—	9	13	mA	—
				V_{CC} = 6V, I_F = 5mA	—	—	17	mA	—
	Low level supply current		I_{CCL}	Ta = 25°C, V_{CC} = 6V, I_F = 0	—	11	15	mA	—
				V_{CC} = 6V, I_F = 0	—	—	20	mA	—
Transfer characteristics	*5"Low→High" threshold input current		I_{FLH}	Ta = 25°C, V_{CC} = 6V, R_{L1} = 5Ω, R_{L2} = 10Ω	0.3	1.5	3.0	mA	5
				V_{CC} = 6V, R_{L1} = 5Ω, R_{L2} = 10Ω	0.2	—	5.0	mA	5
	Isolation resistance		R_{ISO}	Ta = 25°C, DC = 500V, RH = 40~60%	5×10^{10}	10^{11}	—	Ω	—
	Response time	"Low→High" propagation time	t_{PLH}	Ta = 25°C, V_{CC} = 6V, I_F = 5mA, R_{L1} = 5Ω, R_{L2} = 10Ω	—	2	5	μs	6
		"High→Low" propagation time	t_{PHL}		—	2	5	μs	
		Rise time	t_r		—	0.2	1	μs	
		Fall time	t_f		—	0.1	1	μs	
	Instantaneous common mode rejection voltage "Output : high level"		CM_H	Ta = 25°C, V_{CM} = 600$V_{(peak)}$, I_F = 5mA, R_{L1} = 470Ω, R_{L2} = 1kΩ, Δ_{O2H} = 0.5V, V_{CC} = 6V	−1000	—	—	V/μs	7
	Instantaneous common mode rejection voltage "Output : low level"		CM_L	Ta = 25°C, V_{CM} = 600$_{(peak)}$, I_F = 0, R_{L1} = 470Ω, R_{L2} = 1kΩ, ΔV_{O2L} = 0.5V, V_{CC} = 6V	1000	—	—	V/μs	7

*5 I_{FLH} represents forward current when output goes from low to high.

■ Truth Table

Input	Output	Tr.1	Tr.2
ON	High level	ON	OFF
OFF	Low level	OFF	ON

6

■ Test Circuit

Fig. 1

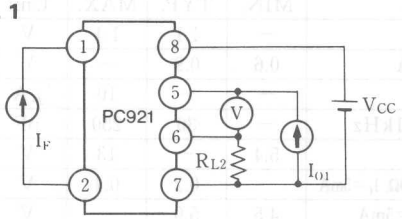


Fig. 2

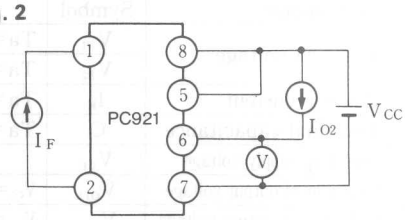


Fig. 3

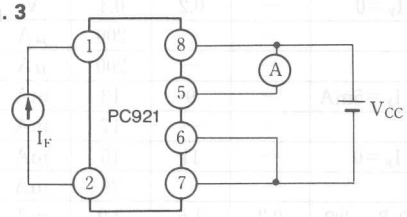


Fig. 4

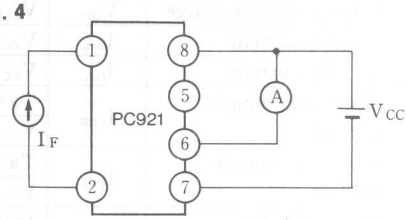


Fig. 5

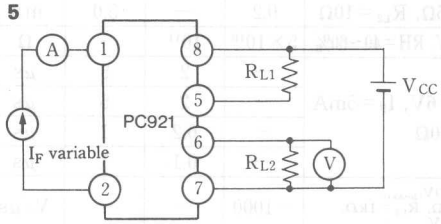


Fig. 6

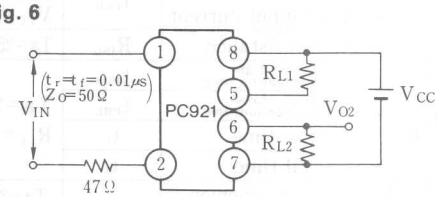
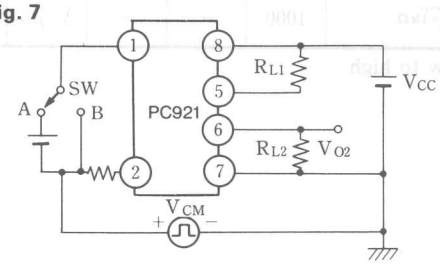
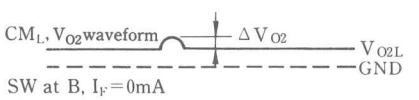


Fig. 7









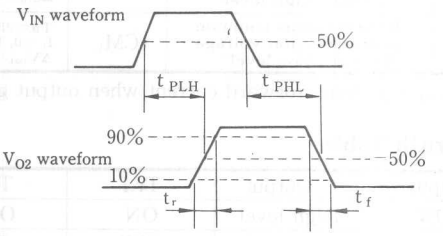


Fig. 8 Forward Current vs. Ambient Temperature

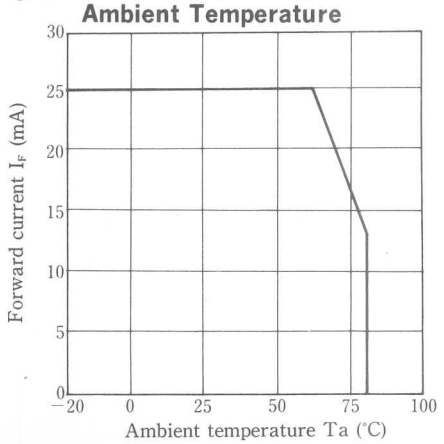


Fig. 9 Output Power Dissipation vs. Ambient Temperature

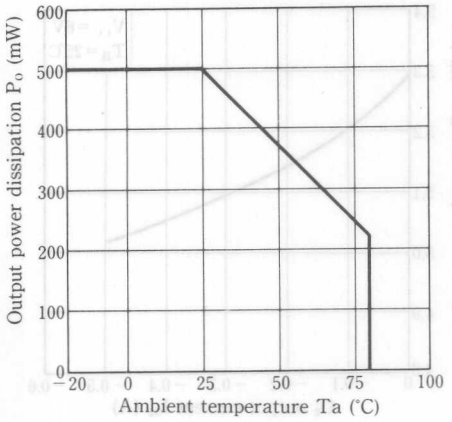


Fig. 10 Total Power Dissipation vs. Ambient Temperature

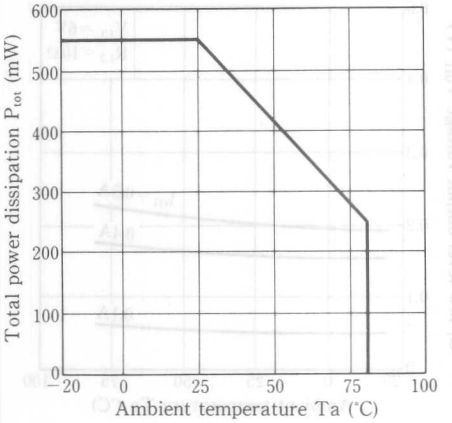


Fig. 11 Forward Current vs. Forward Voltage

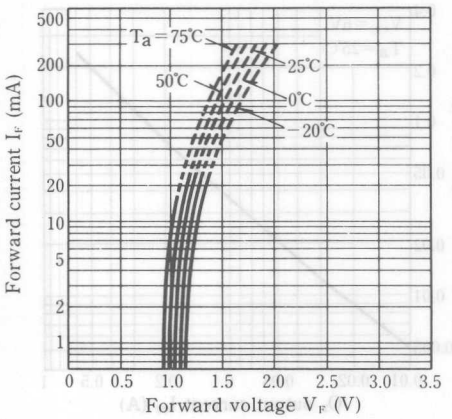


Fig. 12 "Low →High" Relative Threshold Input Current vs. Supply Voltage

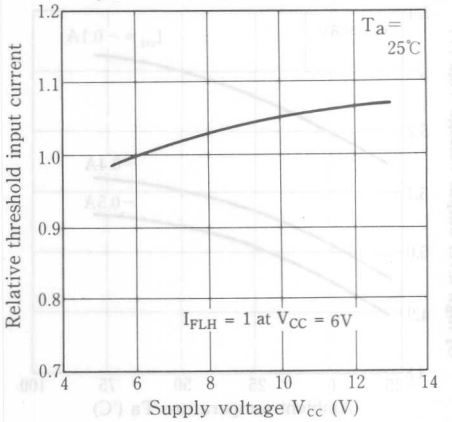


Fig. 13 "Low→High" Relative Threshold Input Current vs. Ambient Temperature

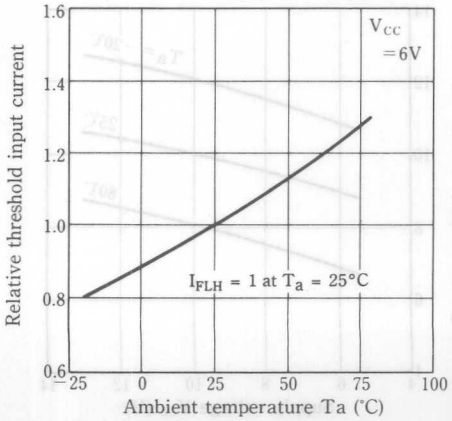
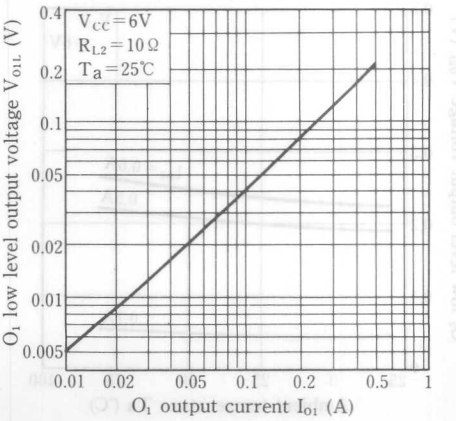


Fig. 14 O_1 Low Level Output Voltage vs. O_1 Output Current



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Fig. 15 O_1 Low Level Output Voltage vs. Ambient Temperature

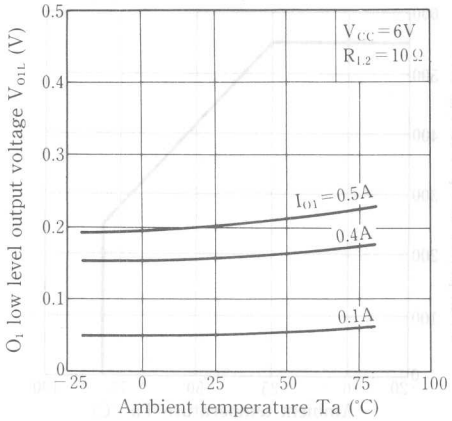


Fig. 16 O_2 High Level Output Voltage vs. O_2 Output Current

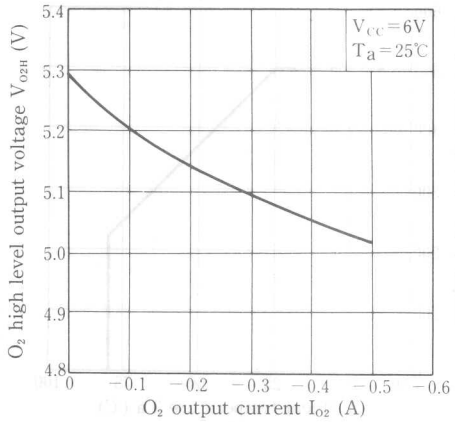


Fig. 17 O_2 High Level Output Voltage vs. Ambient Temperature

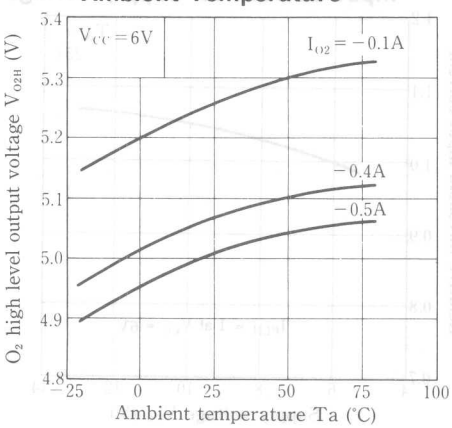


Fig. 18 O_2 Low Level Output Voltage vs. O_2 Output Current

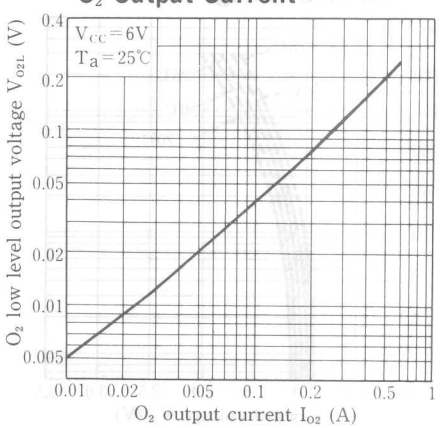


Fig. 19 O_2 Low Level Output Voltage vs. Ambient Temperature

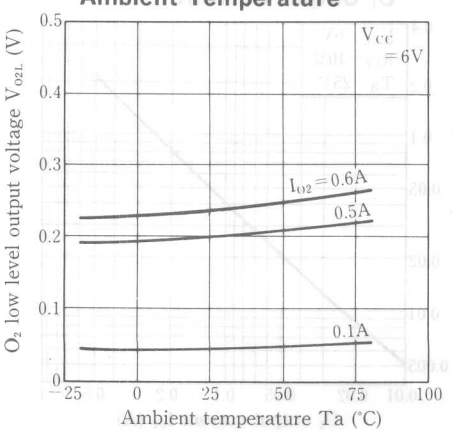


Fig. 20 High Level Supply Current vs. Supply Voltage

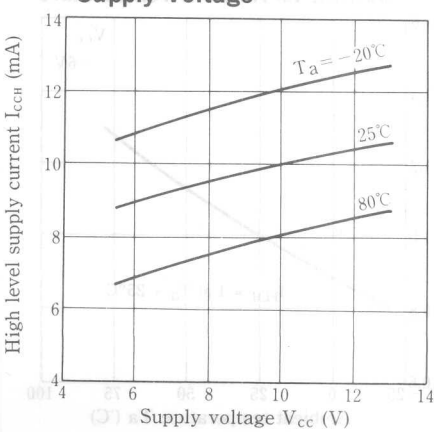


Fig. 21 Low Level Supply Current vs. Supply Voltage

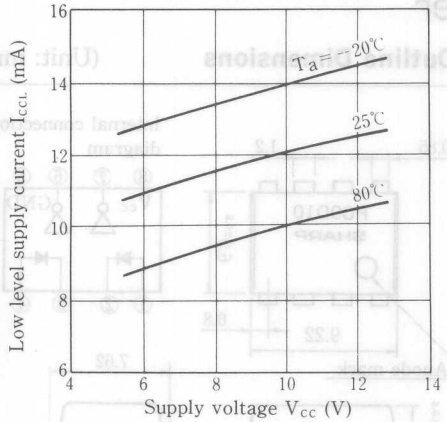


Fig. 22 Propagation Time vs. Forward Current

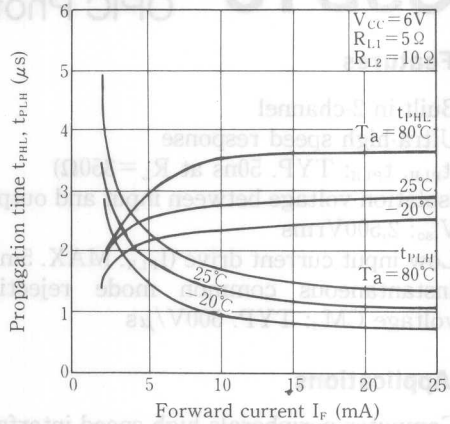


Fig. 23 Propagation Time vs. Ambient Temperature

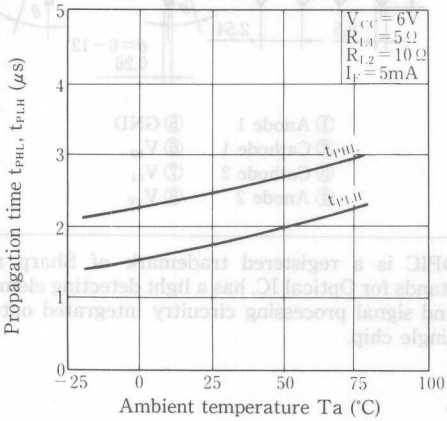
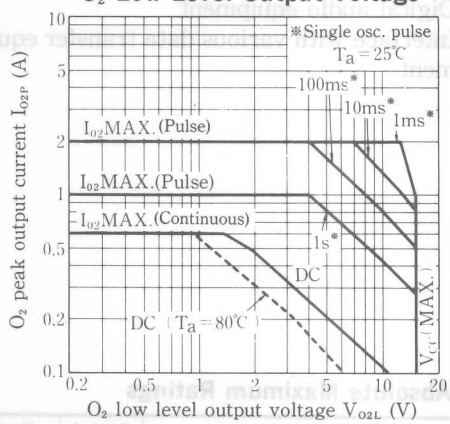


Fig. 24 O_2 Peak Output Current vs. O_2 Low Level Output Voltage



6

PC9D10 Ultra-high Speed Response, 2-channel OPIC Photocoupler

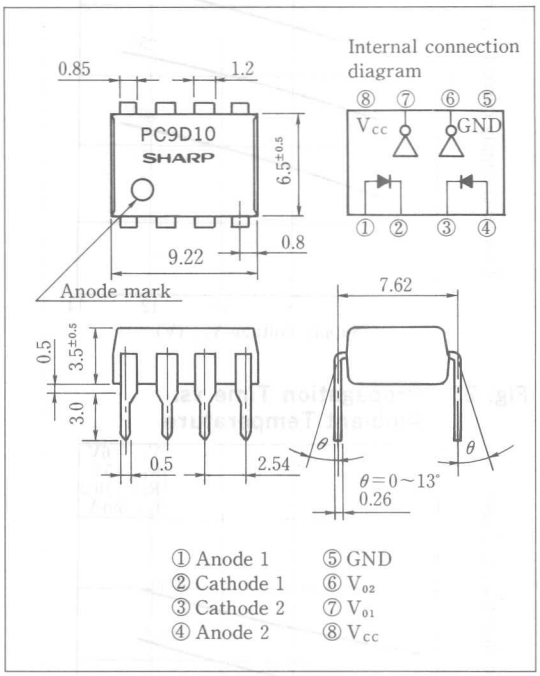
■ Features

1. Built-in 2-channel
2. Ultra-high speed response
   (t_{PLH}, t_{PLH}: TYP. 50ns at $R_L = 350\Omega$)
3. Isolation voltage between input and output
   V_{iso}: 2,500Vrms
4. Low input current drive (I_{FLH}: MAX. 5mA)
5. Instantaneous common mode rejection voltage CM_H: TYP. 500V/μs

■ Applications

1. Computer peripherals high speed interface for microcomputer systems
2. High speed line receivers
3. Digital audio equipment
4. Interface with various data transfer equipment

■ Outline Dimensions (Unit: mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	*1 *2Forward current	I_F	15	mA
	*2Reverse voltage	V_R	5	V
	*2Power dissipation	P	40	mW
Output	*3Supply voltage	V_{CC}	7	V
	*2High level output voltage	V_{OH}	7	V
	*2Low level output current	I_{OL}	16	mA
	Collector power dissipation	P_C	60	mW
*4Isolation voltage		V_{iso}	2,500	V_{rms}
Operating temperature		T_{opr}	0~+70	°C
Storage temperature		T_{stg}	−55~+125	°C
*5Soldering temperature		T_{sol}	260	°C

*1 Ta=0~70°C
*2 Each channel
*3 For 1 minute max.
*4 AC for 1 minute, 40~60%RH. Apply the specified voltage between the whole of the electrode pins on the input side and the whole of the electrode pins on the output side.
*5 2mm or more away from the lead base for 10 seconds or less

■ Electro-optical Characteristics

(Unless otherwise specified, Ta=0~70°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	Ta=25°C, I_F=10mA	—	1.6	1.75	V
	Reverse current		I_R	Ta=25°C, V_R=5V	—	—	10	μA
	Terminal capacitance		C_t	Ta=25°C, V=0, f=1MHz	—	60	250	pF
Output	High level output current		I_{OH}	V_{CC}=V_O=5.5V, I_F=250μA	—	2	250	μA
	Low level output voltage		V_{OL}	V_{CC}=5.5V, I_F=5mA, I_{OL}=13mA	—	0.4	0.6	V
	High level supply current		I_{CCH}	V_{CC}=5.5V, I_F=0	—	14	30	mA
	Low level supply current		I_{CCL}	V_{CC}=5.5V, I_F=10mA	—	26	36	mA
Transfer characteristics	"High→Low" threshold input current		I_{FHL}	V_{CC}=5V, V_O=0.8V, R_L=350Ω	—	2.5	5	mA
	Isolation resistance		R_{ISO}	Ta=25°C, DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance		C_f	Ta=25°C, V=0, f=1MHz	—	0.6	—	pF
	Current transfer ratio		CTR	Ta=25°C, V_{CC}=5V, I_F=5mA, R_L=100Ω	—	700	—	%
	Response time	"High→Low" propagation delay time	t_{PHL}	Ta=25°C, V_{CC}=5V, Fig. 1	—	50	75	ns
		"Low→High" propagation delay time	t_{PLH}	R_L=350Ω, C_L=15pF	—	50	75	ns
		Rise time, fall time	t_r, t_f	I_F=7.5mA	—	30	60	ns
	CMR	Instantaneous common mode rejection voltage "High level output"	CM_H	Ta=25°C, V_{CC}=5V, $V_{O(MIN)}$=2V, V_{CM}=10V, R_L=350Ω, I_F=0, Fig. 2	100	500	—	V/μs
		Instantaneous common mode rejection voltage "Low level output"	CM_L	Ta=25°C, V_{CC}=5V, $V_{O(MAX)}$=0.8V, V_{CM}=10V, R_L=350Ω, I_F=5mA Fig. 2	−100	−500	—	V/μs

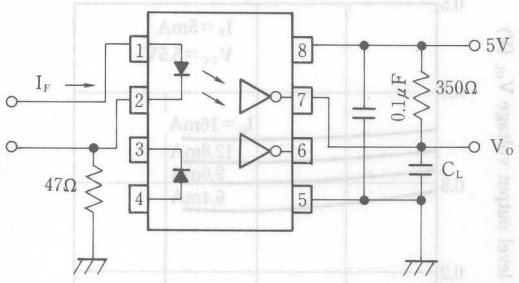
Typical values are all at Ta=25°C, V_{CC}=5V

■ Recommended Operating Conditions

Parameter	Symbol	MIN.	MAX.	Unit
Low level input current	I_{FL}	0	250	μA
High level input current	I_{FH}	7	15	mA
Supply voltage	V_{CC}	4.5	5.5	V
Fanout (TTL load)	N	—	8	—
Operating temperature	T_{opr}	0	70	°C

Connect a ceramic by-pass capacitor (0.01~0.1μF) between V_{CC} and GND at the position within 1cm from pin.

Fig. 1 Test Circuit for t_{PLH}, t_{PHL}, t_r and t_f



※C_L includes probe and wiring capacity.

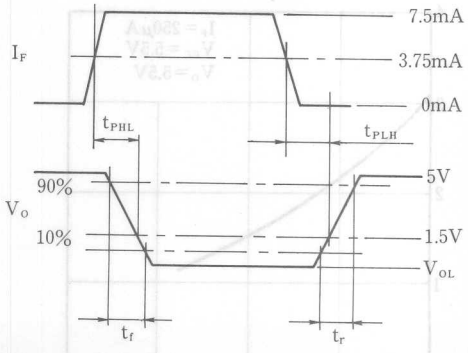


Fig. 2 Test Circuit for C_{MH} and C_{ML}

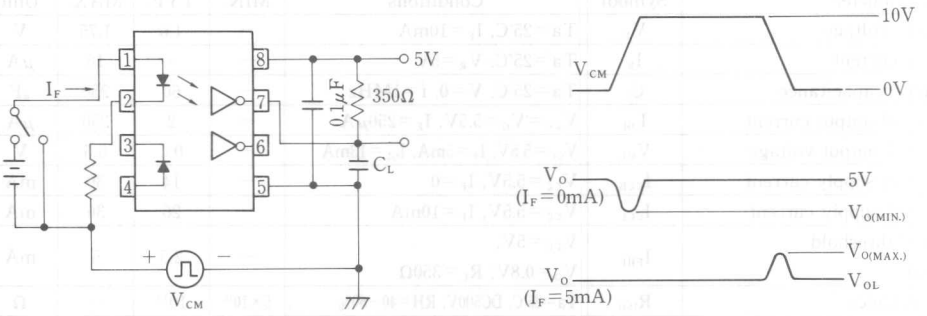


Fig. 3 Output Collector Power Dissipation vs. Ambient Temperatur

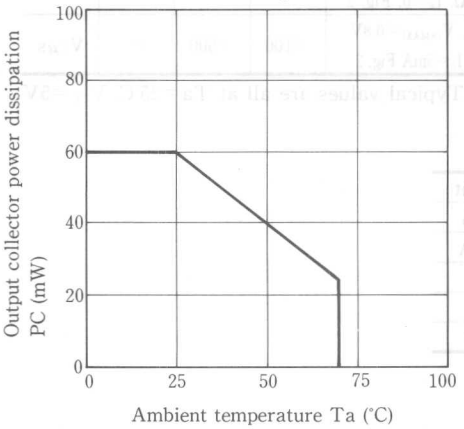


Fig. 4 Forward Current vs. Forward Voltage

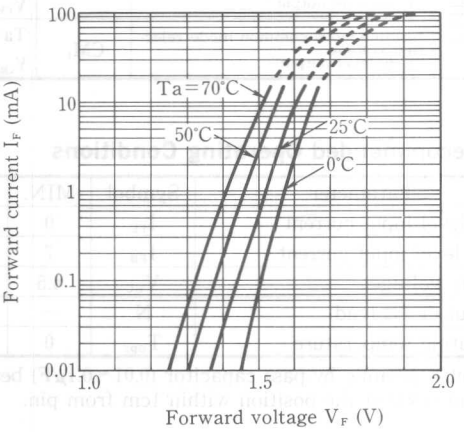


Fig. 5 High level Output Current vs. Ambient Temperature

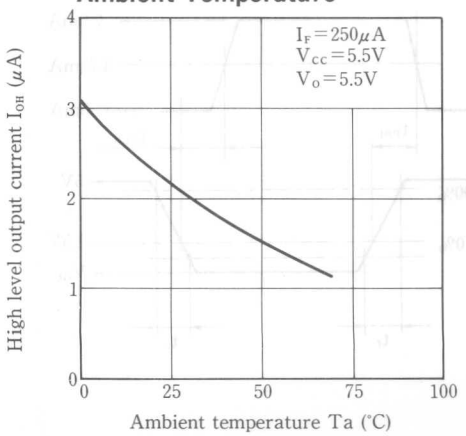


Fig. 6 Low Level Output Voltage vs. Ambient Temperature

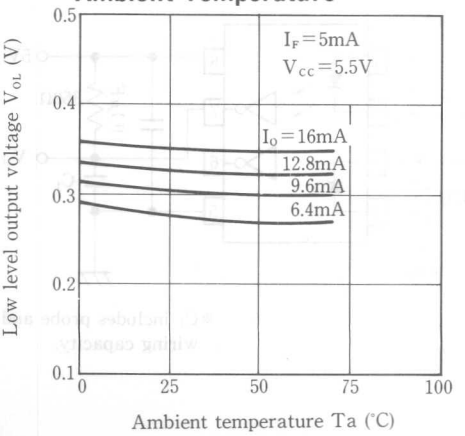


Fig. 7 Output Voltage vs. Forward Current

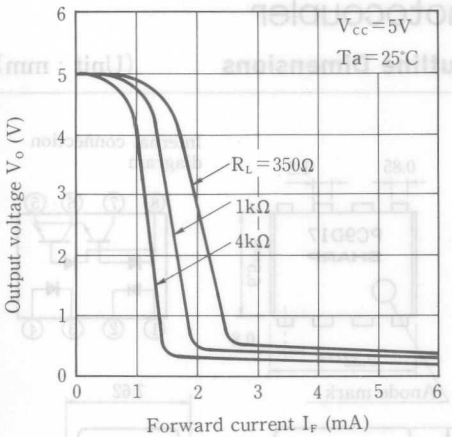


Fig. 8 Output Voltage vs. Forward Current (Ambient temperature characteristics)

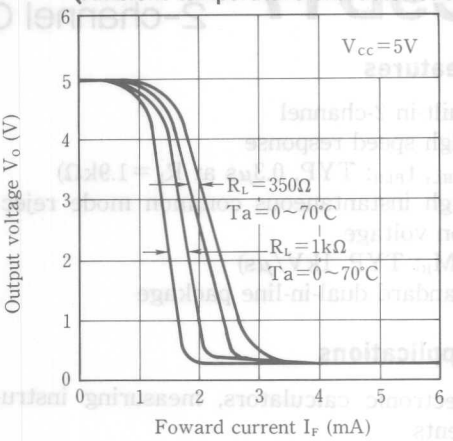


Fig. 9 Propagation Time vs. Forward Current

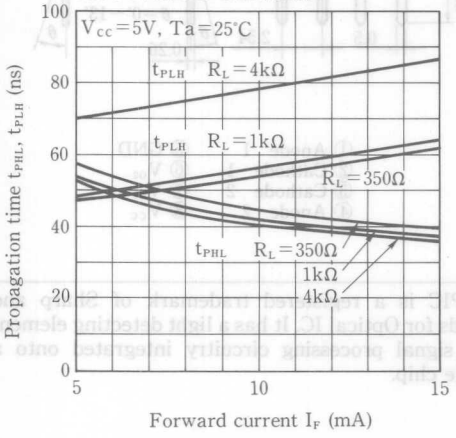


Fig. 10 Propagation Time vs. Ambient Temperature

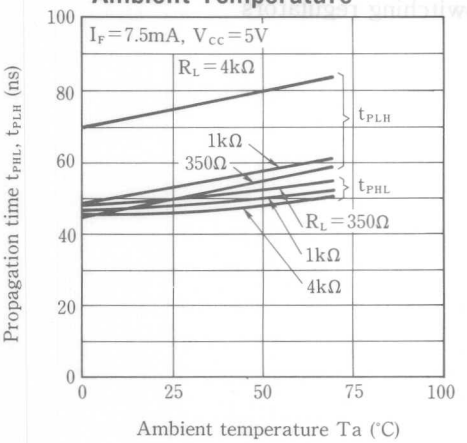
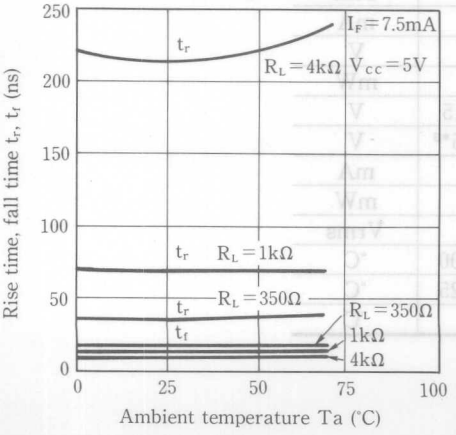


Fig. 11 Rise Time, Fall Time vs. Ambient Temperature



■ Handling precaution

Handle this product the same as with other integrated circuits against static electricity.

6

PC9D17 High Speed, High Common Mode Rejection, 2-channel OPIC Photocoupler

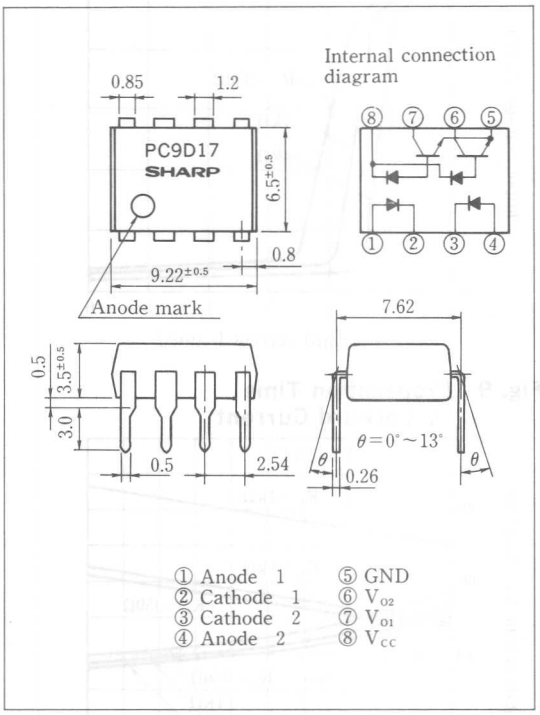
■ Features

1. Built-in 2-channel
2. High speed response
   (t_{PHL}, t_{PLH}: TYP. 0.3μs at R_L=1.9kΩ)
3. High instantaneous common mode rejection voltage
   (CM_H: TYP. 1kV/μs)
4. Standard dual-in-line package

■ Applications

1. Electronic calculators, measuring instruments
2. Digital audio equipment
3. High speed line receivers
4. Switching regulators

■ Outline Dimensions (Unit : mm)



* OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	25*3	mA
	Reverse voltage	V_R	5*3	V
	Power dissipation	P	45*3	mW
Output	Supply voltage	V_{CC}	−0.5~+15	V
	Output voltage	V_O	−0.5~+15*3	V
	Output current	I_O	8*3	mA
	Power dissipation	P_O	35*3	mW
*1Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	−55~+100	°C
Storage temperature		T_{stg}	−55~+125	°C
*2Soldering temperature		T_{sol}	260	°C

*1 RH=40~60%, AC for 1 minute
*2 For 10 seconds
*3 Each channel

■ Electro-optical Characteristics (Unless otherwise specified, Ta=0~70°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	Ta=25°C, I_F=16mA	—	1.7	1.95	V
	Reverse current	I_R	Ta=25°C, V_R=5V	—	—	10	μA
	Terminal capacitance	C_t	Ta=25°C, V_F=0, f=1MHz	—	60	250	pF
Output	High level output current (1)	$I_{OH(1)}$	Ta=25°C, I_F=0, V_{CC}=V_O=5.5V	—	—	500	nA
	High level output current (2)	$I_{OH(2)}$	Ta=25°C, I_F=0, V_{CC}=V_O=15V	—	—	1	μA
	High level output current (3)	$I_{OH(3)}$	I_F=0, V_{CC}=V_O=15V	—	—	50	μA
	Low level output voltage	V_{OL}	I_F=16mA, I_O=2.4mA, V_{CC}=4.5V	—	—	0.4	V
	Low level supply current	I_{CCL}	I_F=16mA, V_O=open, V_{CC}=15V	—	400	—	μA
	High level supply current (1)	$I_{CCH(1)}$	Ta=25°C, I_F=0, V_O=open, V_{CC}=15V	—	0.02	1	μA
	High level supply current (2)	$I_{CCH(2)}$	I_F=0, V_O=open, V_{CC}=15V	—	—	2	μA
Transfer characteristics	Current transfer ratio	CTR	Ta=25°C, I_F=16mA, V_O=0.4V, V_{CC}=4.5V	19	—	—	%
	Isolation resistance	R_{ISO}	Ta=25°C, DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Floating capacitance	C_f	Ta=25°C, V=0, f=1MHz	—	0.6	—	pF
	"High→Low" Propagation delay time	t_{PHL}	Ta=25°C, R_L=1.9kΩ Fig. 1 I_F=16mA, V_{CC}=5V	—	0.3	0.8	μs
	"Low→High" propagation delay time	t_{PLH}	Ta=25°C, R_L=1.9kΩ Fig. 1 I_F=16mA, V_{CC}=5V	—	0.3	0.8	μs
	Instantaneous common mode rejection voltage "High level output"	CM_H	Ta=25°C, I_F=0, R_L=1.9kΩ V_{CM}=10V_{p-p}, V_{CC}=5V Fig. 2	—	1000	—	V/μs
	Instantaneous common mode rejection voltage "Low level output"	CM_L	Ta=25°C, I_F=16mA, R_L=1.9kΩ V_{CM}=10V_{p-p}, V_{CC}=5V Fig. 2	—	−1000	—	V/μs

All typical values: at Ta=25°C, Vcc=5V

■ Recommended Operating Conditions

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Forward current	I_F	—	—	16	mA
Supply voltage	V_{CC}	—	5	—	V
Operating temperature	T_{opr}	0	—	70	°C

6

Fig. 1 Test Circuit for Propagation Delay Time

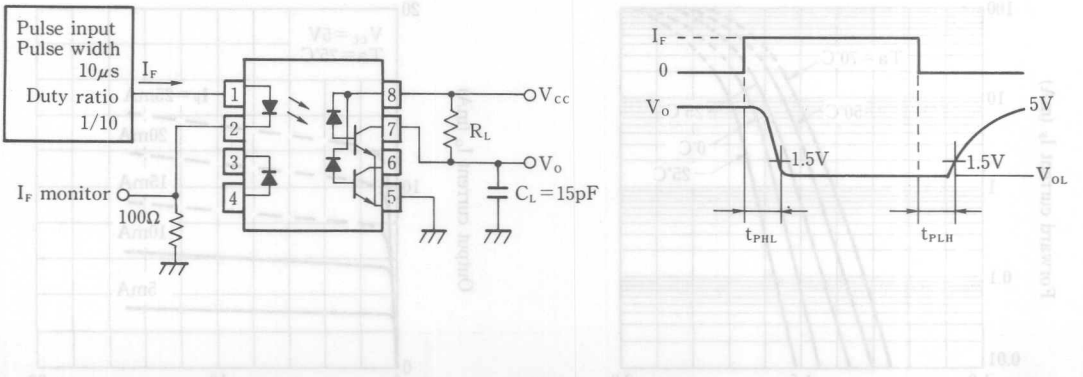


Fig. 2 Test Circuit for Instantaneous Common Mode Rejection Voltage

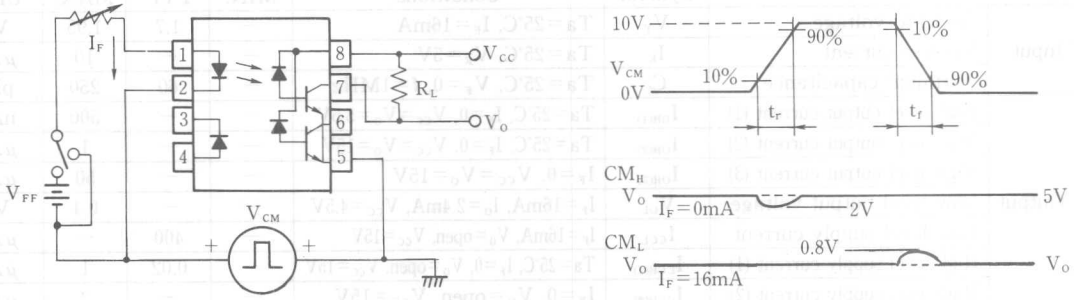


Fig. 3 Forward Current vs. Ambient Temperature

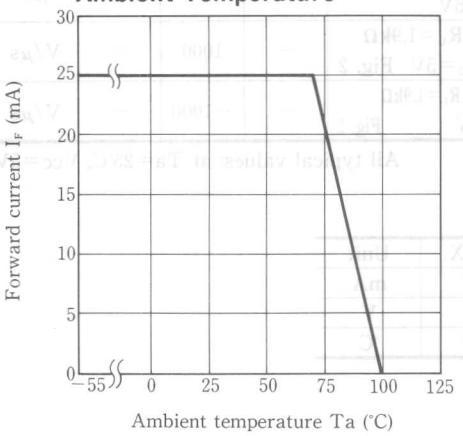


Fig. 4 Power Dissipation vs. Ambient Temperature

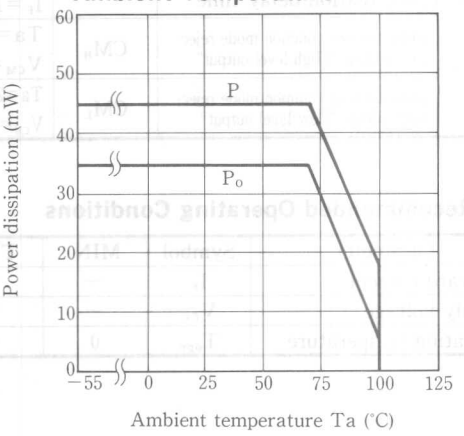


Fig. 5 Forward Current vs. Forward Voltage

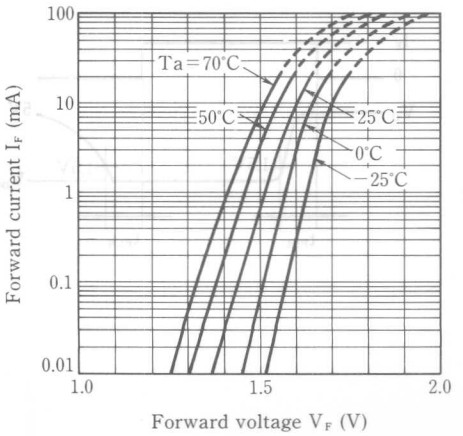


Fig. 6 Output Current vs. Output Voltage

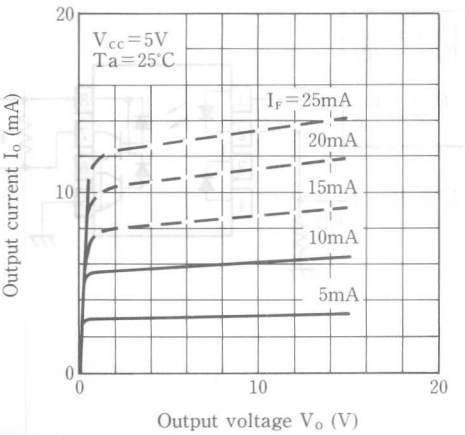


Fig. 7 Relative Current Transfer Ratio vs. Forward Current

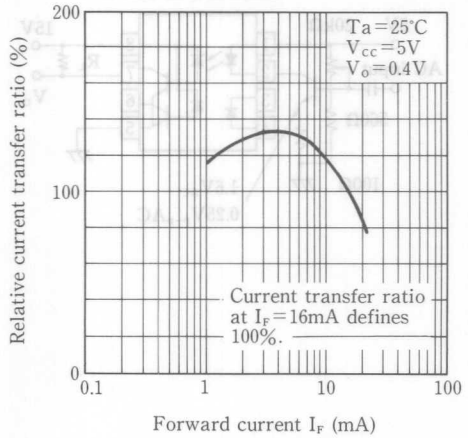


Fig. 8 Relative Current Transfer Ratio vs. Ambient Temperature

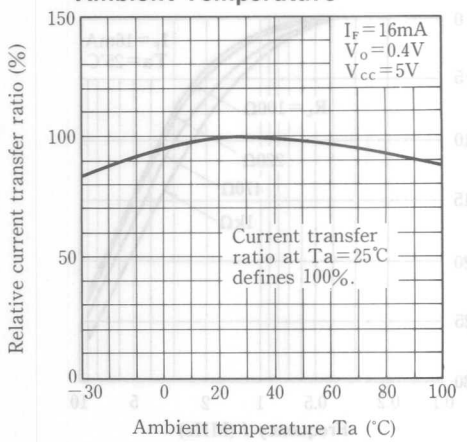


Fig. 9 Propagation Delay Time vs. Ambient Temperature

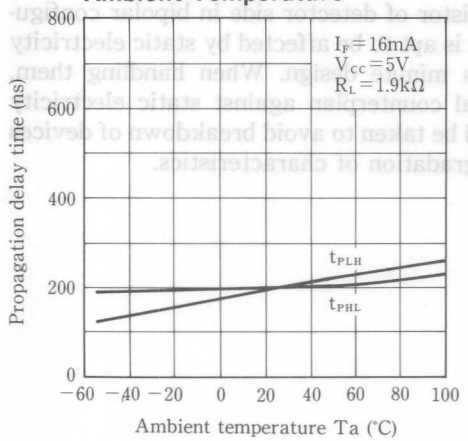


Fig. 10 Propagation Delay Time vs. Load Resistance

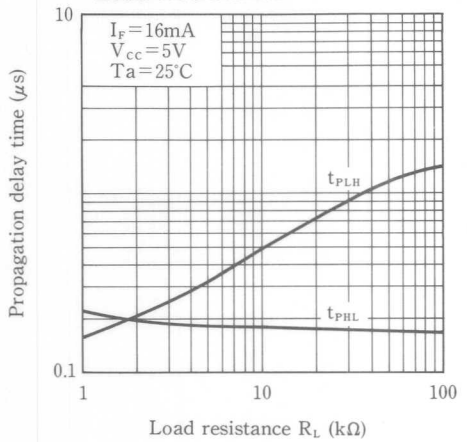


Fig. 11 Output Voltage vs. Forward Current

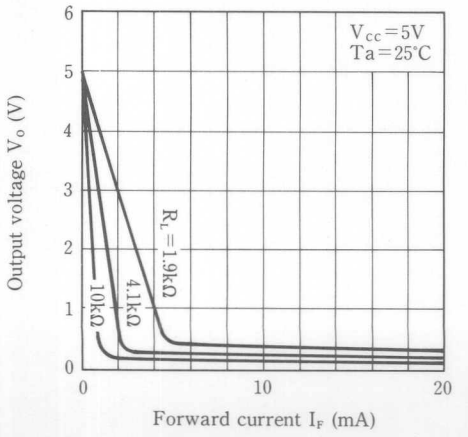
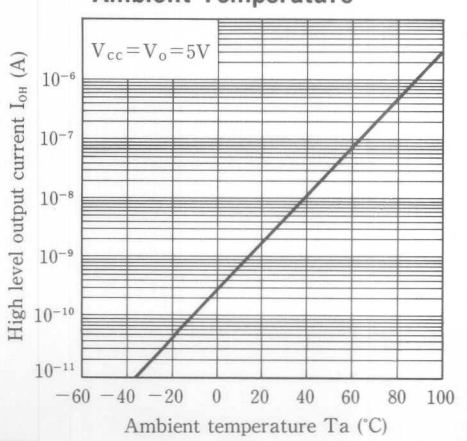
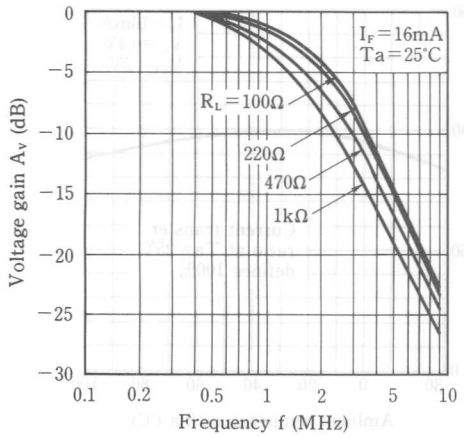


Fig. 12 High Level Output Current vs. Ambient Temperature

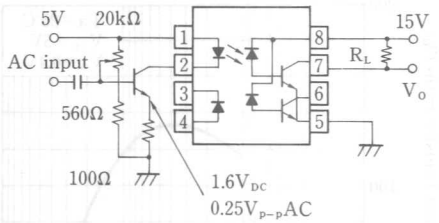


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Fig. 13 Frequency Response



Test Circuit for Frequency Response



■ Handling precaution

Transistor of detector side in bipolar configuration is apt to be affected by static electricity for its minute design. When handling them, general counterplan against static electricity should be taken to avoid breakdown of devices or degradation of characteristics.

S11MD3 High Noise-reduction Type Phototriac Coupler

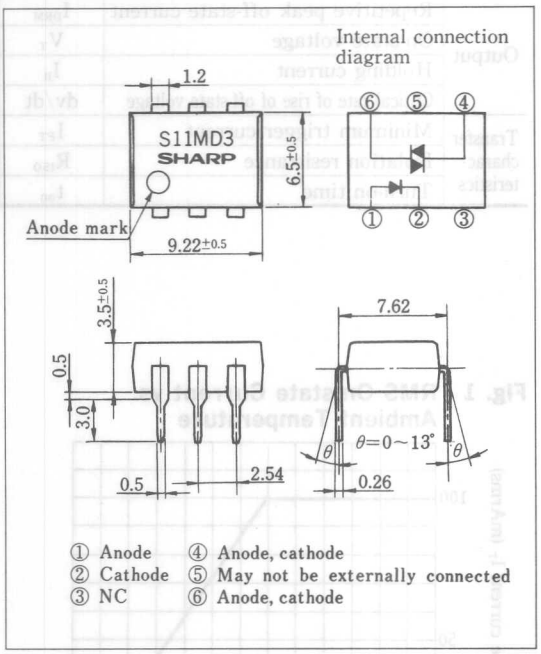
■ Features

1. High critical rate of rise of off-state voltage (dv/dt: MIN. 100V/μs)
2. Low trigger current (I_{FT}: MAX. 10mA)
3. High repetitive peak off-state voltage (V_{DRM}: MIN. 400V)
4. Isolation voltage between input and output V_{iso}: 2,500Vrms
5. UL recognized, file No. E64380

■ Applications

1. On-off operation for a low power load
2. For triggering high power triac

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
Output	RMS on-state current	I_T	100	mArms
	*1Peak one cycle surge current	I_{surge}	1.2	A
	Repetitive peak off-state voltage	V_{DRM}	400	V
*2Isolation voltage		V_{iso}	2,500	Vrms
Operating temperature		T_{opr}	−30~+100	°C
Storage temperature		T_{stg}	−55~+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 50Hz, sine wave
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

6

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive peak off-state current	I_{DRM}	V_{DRM}=Rated	—	—	10^{-6}	A
	On-state voltage	V_T	I_T=100mA	—	1.3	2.0	V
	Holding current	I_H	V_D=6V	0.5	1	3.5	mA
	Critical rate of rise of off-state voltage	dv/dt	V_{DRM}=1/√2 Rated	100	—	—	V/μs
Transfer characteristics	Minimum trigger current	I_{FT}	V_D=6V, R_L=100Ω	—	—	10	mA
	Isolation resistance	R_{ISO}	DC 500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Turn-on time	t_{on}	V_D=6V, I_F=20mA, R_L=100Ω	—	40	100	μs

Fig. 1 RMS On-state Current vs. Ambient Temperature

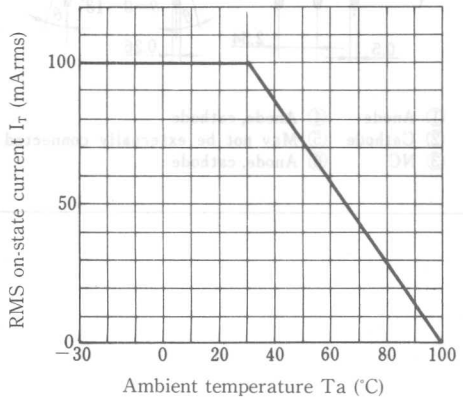


Fig. 2 Forward Current vs. Ambient Temperature

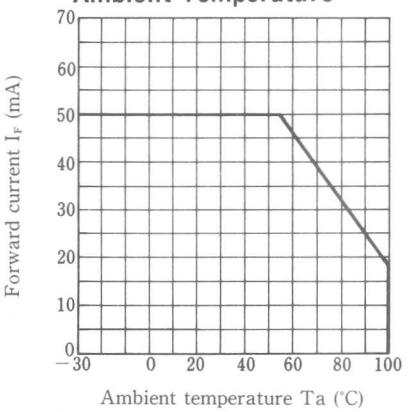


Fig. 3 Forward Current vs. Forward Voltage

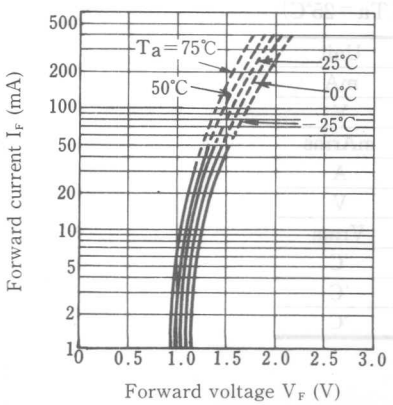


Fig. 4 Minimum Trigger Current vs. Ambient Temperature

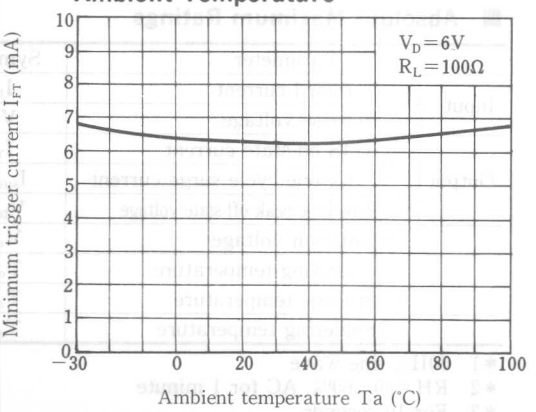


Fig. 5 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature

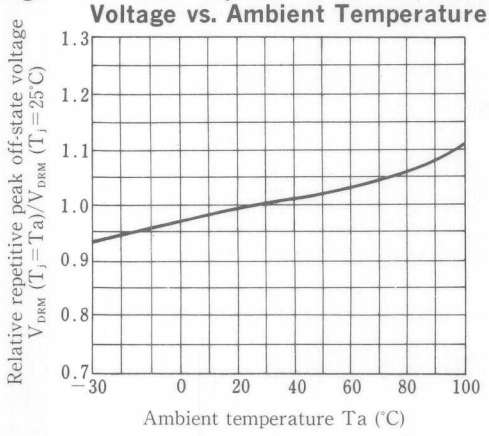


Fig. 6 On-state Voltage vs. Ambient Temperature

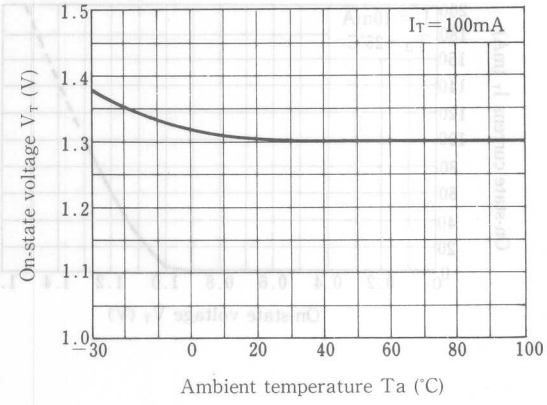


Fig. 7 Holding Current vs. Ambient Temperature

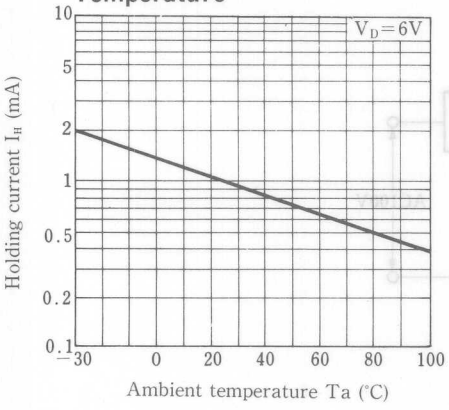


Fig. 8 Repetitive Peak Off-state Current vs. Off-state Voltage

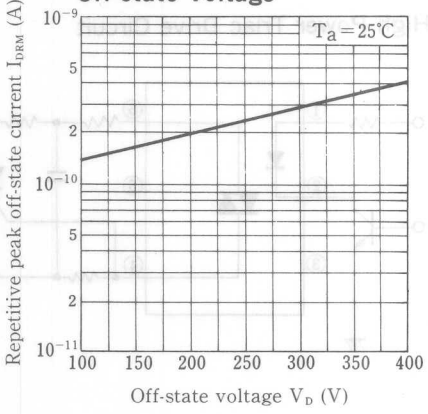


Fig. 9 Repetitive Peak Off-state Current vs. Ambient Temperature

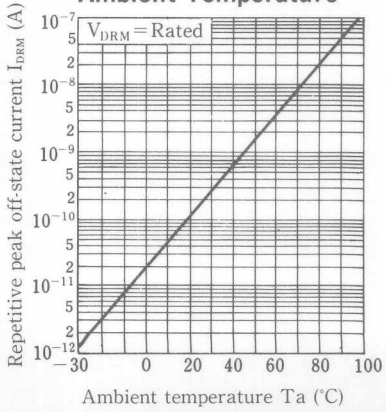
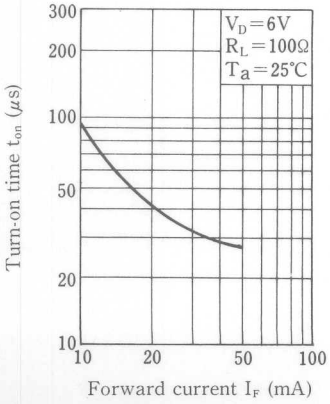
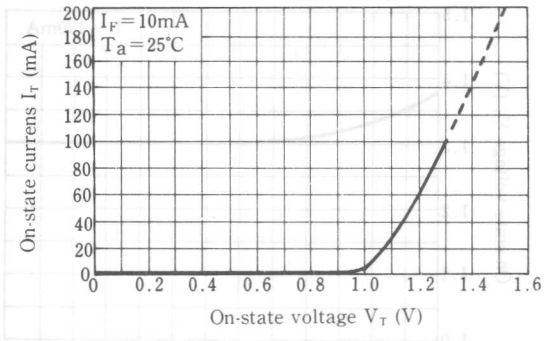


Fig. 10 Turn-on Time vs. Forward Current



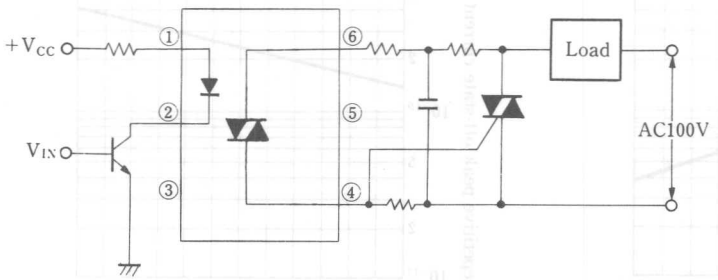
6

Fig. 11 On-state Current vs. On-state Voltage



Basic Operation Circuit

High Power Triac Drive Circuit



S11MD5V Phototriac Coupler
S11MM5 Mini-flat Type Phototriac Coupler

※ Lead forming type (I type) of S11MD5V is also available. (S11MD5VI) (Page 482)

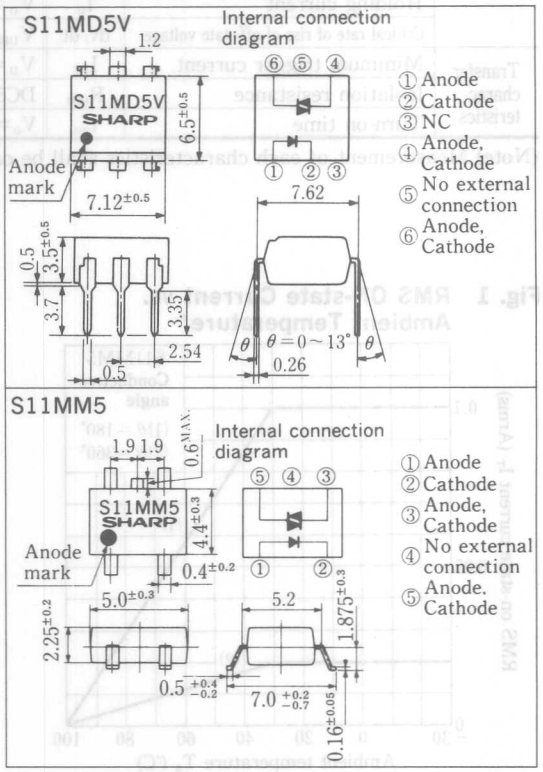
■ Features

1. Mini-flat package type (S11MM5)
2. Ultra-compact (5.0×4.4×2.25mm) (S11MM5)
3. Isolation voltage between input and output
   V_{iso}: 5,000Vrms (S11MD5V)
   V_{iso}: 2,500Vrms (S11MM5)
4. High critical rate of rise off-state voltage (d_V/dt: MIN. 100V/μs)
5. UL recognized, file No. E64380 (S11MD5V/S11MD5VI)

■ Applications

1. For triggering medium/high power triac
2. Hybrid substrate that requires high density mounting (S11MM5)

■ Outline Dimensions (Unit : mm)



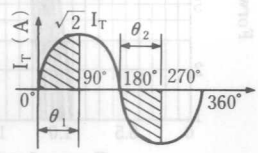
■ Absolute Maximum Ratings

(T_a=25°C)

Parameter		Symbol	Rating S11MD5V	Rating S11MM5	Unit
Input	Forward current	I_F	50		mA
	Reverse voltage	V_R	6		V
Output	*1 RMS on-state current	I_T	100		mArms
	*2 Peak one cycle surge current	I_{surge}	1.2		A
	Repetitive peak off-state voltage	V_{DRM}	400		V
*3 Isolation voltage		V_{iso}	5,000	2,500	Vrms
Operating temperature		T_{opr}	−30~+100		°C
Storage temperature		T_{stg}	−55~+125	−40~+125	°C
*4 Soldering temperature		T_{sol}	260		°C

*1 The conductive angle θ of the RMS on-state current I_T shall satisfy the relation as follows. (S11MM5)
θ (conductive angle)$=\theta_1+\theta_2\leqq 180°$
For the definition, see the figure on the right. For the derating curve, see Fig. 1.

*2 Sine wave
*3 RH=40~60%, AC for 1 minute
*4 For 10 seconds



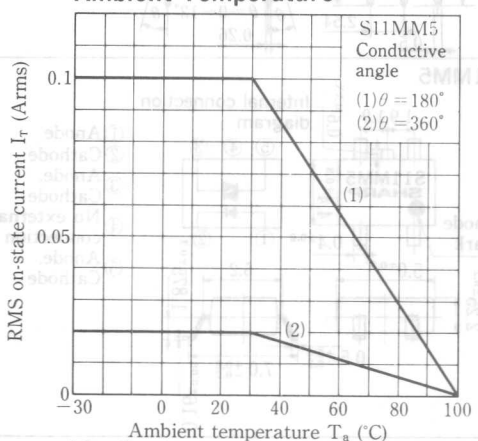
■ Electro-optical Characteristics

(T_a=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive peak off-state current	I_{DRM}	V_{DRM}=Rated	—	—	10^{-6}	A
	On-state voltage	V_T	I_T=100mA	—	1.3	2.0	V
	Holding current	I_H	V_D=6V	0.1	1	3.5	mA
	Critical rate of rise of off-state voltage	dv/dt	V_{DRM}=1/$\sqrt{2}$ Rated	100	—	—	V/μs
Transfer characteristics	Minimum trigger current	I_{FT}	V_D=6V, R_L=100Ω	—	—	10	mA
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Turn-on time	t_{on}	V_D=6V, I_F=20mA, R_L=100Ω	—	80	200	μs

(Note) Measurement of each characteristics shall be carried out in opaque condition.

Fig. 1 RMS ON-state Current vs. Ambient Temperature*



*See the above graph (1) for the S11MD5V regardless of the conductive angle θ.

Fig. 2 Forward Current vs. Ambient Temperature

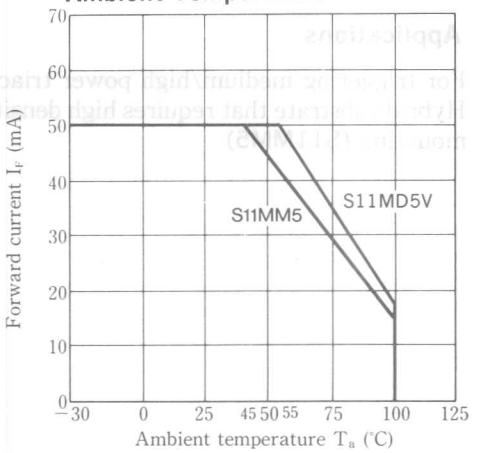


Fig. 3 Forward Current vs. Forward Voltage

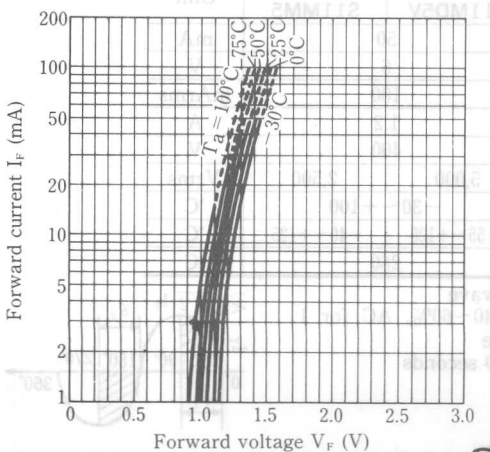


Fig. 4 Minimum Trigger Current vs. Ambient Temperature

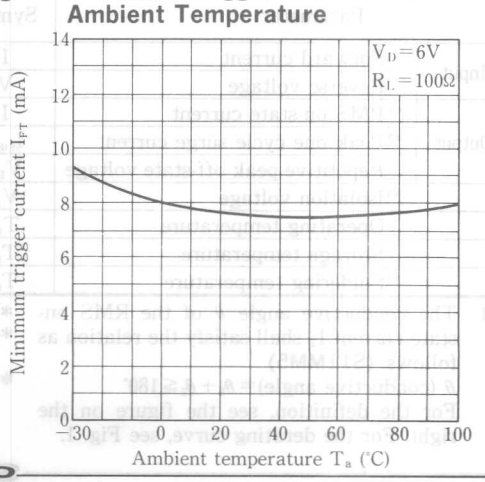


Fig. 5 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature

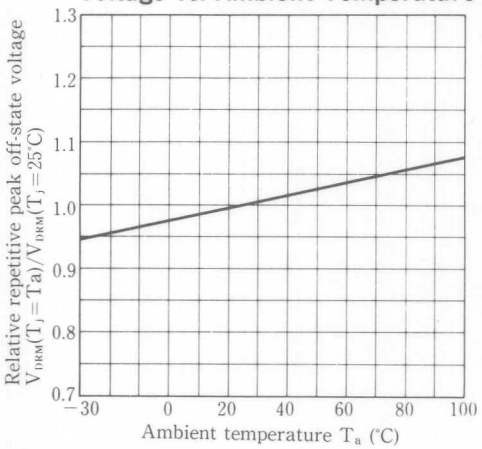


Fig. 6 On-state Voltage vs. Ambient Temperature

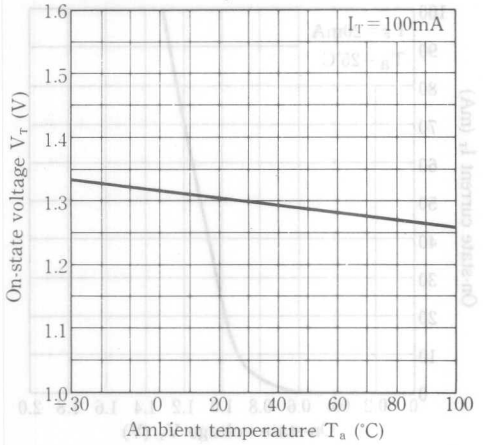


Fig. 7 Holding Current vs. Ambient Temperature

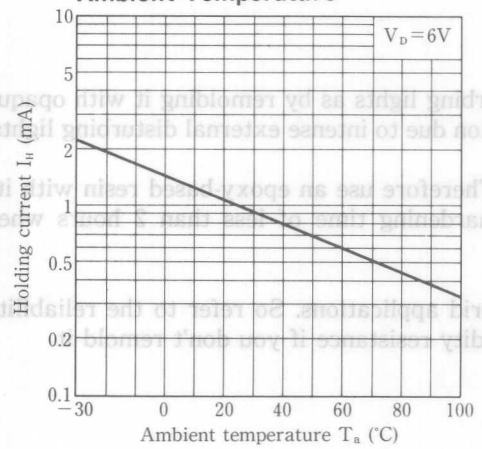


Fig. 8 Repetitive Peak Off-state Current vs. Off-state Voltage

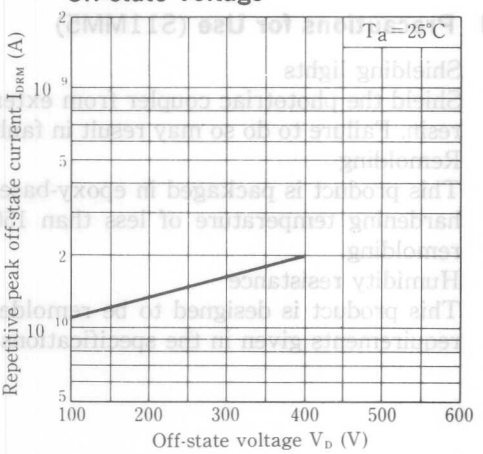


Fig. 9 Relative Peak Off-state Current vs. Ambient Temperature

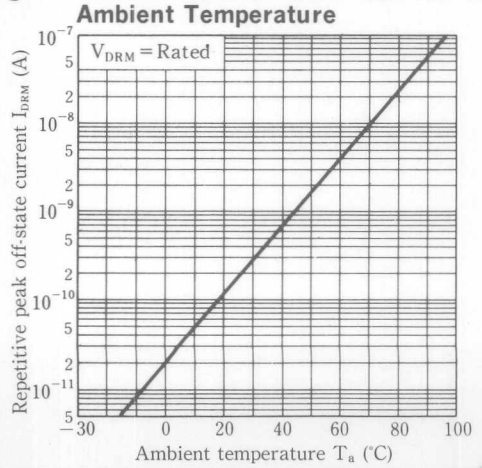
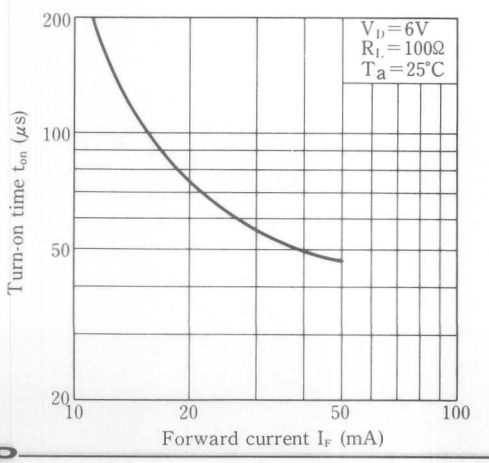
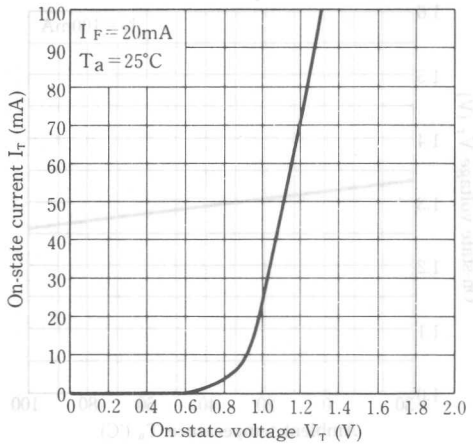


Fig. 10 Turn-on Time vs. Forward Current



6

Fig. 11 On-state Current vs. On-state Voltage



■ Precautions for Use (S11MM5)

1. Shielding lights
   Shield the phototriac coupler from external disturbing lights as by remolding it with opaque resin. Failure to do so may result in faulty operation due to intense external disturbing lights.
2. Remolding
   This product is packaged in epoxy-based resin. Therefore use an epoxy-based resin with its hardening temperature of less than 150°C and hardening time of less than 2 hours when remolding.
3. Humidity resistance
   This product is designed to be remolded for hybrid applications. So refer to the reliability requirements given in the specifications for humidity resistance if you don't remold it.

S11MD5T/S21MD3TV/S21MD4TV High Noise-reduction Type Phototriac Coupler

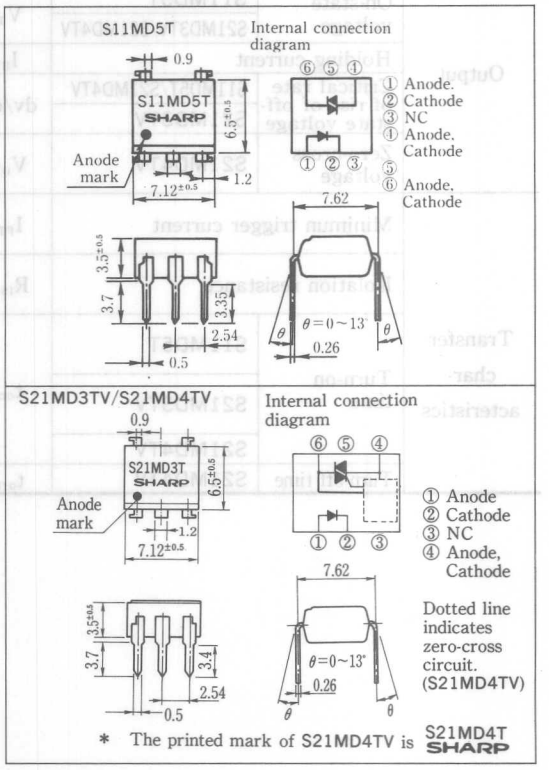
■ Features

1. No. 5 pin completely sealed in the mold for external noise resistance
2. Built-in zero-cross circuit (S21MD4TV)

■ Applications

1. For triggering of power triac

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating		Unit
			S11MD5T	S21MD3TV/S21MD4TV	
Input	Reverse current	I_F	50		mA
	Reverse voltage	V_R	6		V
Output	RMS on-state current	I_T	0.1		Arms
	*1Peak one cycle surge current	I_{surge}	1.2		A
	Repetitive peak off-state voltage	V_{DRM}	400	600	V
*2Isolation voltage		V_{iso}	5,000		Vrms
Operating temperature		T_{opr}	−30～+100		°C
Storage temperature		T_{stg}	−55～+125		°C
*3Soldering temperature		T_{sol}	260		°C

*1 Sine wave
*2 RH=40～60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	S11MD5T/S21MD4TV	V_F	I_F=20mA	—	1.2	1.4	V
		S21MD3TV		I_F=30mA				
	Reverse current		I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive peak off-state current		I_{DRM}	$V_{DRM}=R_{ated}$	—	—	10^{-6}	A
	On-state voltage	S11MD5T	V_T	I_T=0.1A	—	1.3	2.0	V
		S21MD3TV/S21MD4TV			—	1.7	2.5	V
	Holding current		I_H	V_D=6V	0.1	1	3.5	mA
	Critical rate of rise of off-state voltage	S11MD5T/S21MD4TV	dv/dt	$V_{DRM}=1/\sqrt{2}\,R_{ated}$	100	—	—	V/μs
		S21MD3TV			500	—	—	V/μs
	Zero-cross voltage	S21MD4TV	V_{OX}	Load resistance I_F=15mA	—	—	35	V
Transfer characteristics	Minimun trigger current		I_{FT}	V_D=6V R_L=100Ω	—	—	10	mA
	Isolation resistance		R_{ISO}	DC500V RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Turn-on time	S11MD5T	t_{on}	V_D=6V, I_F=20mA R_L=100Ω	—	80	200	μs
		S21MD3TV		V_D=6V, I_F=30mA R_L=100Ω	—	100	250	μs
		S21MD4TV		f=50Hz	—	—	1/2	cycle
	Turn-off time	S21MD4TV	t_{off}	f=50Hz	—	—	1/2	cycle

Fig. 1 RMS On-state Current vs. Ambient Temperature

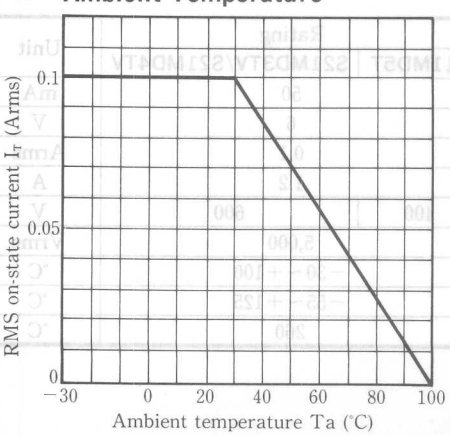


Fig. 2 Forward Current vs. Ambient Temperature

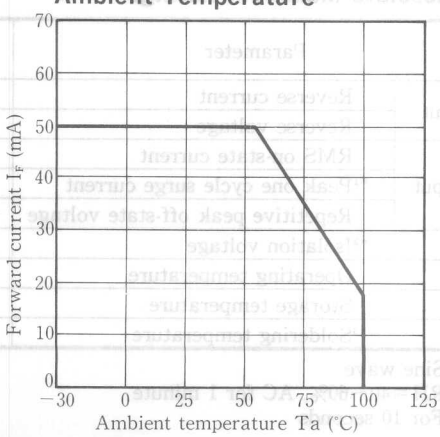


Fig. 3 Forward Current vs. Forward Voltage

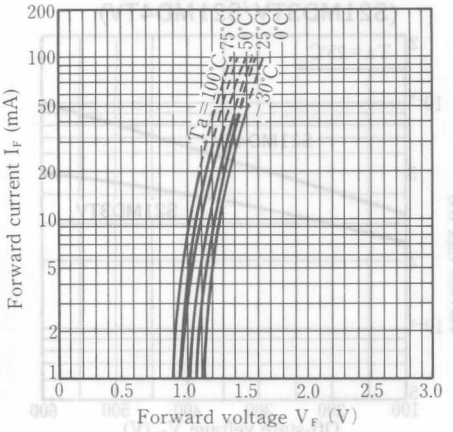


Fig. 4 Minimum Trigger Current vs. Ambient Temperature

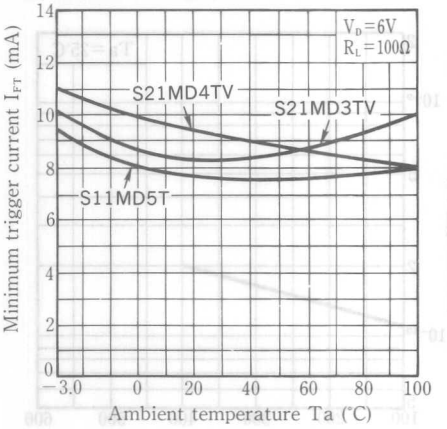


Fig. 5 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature

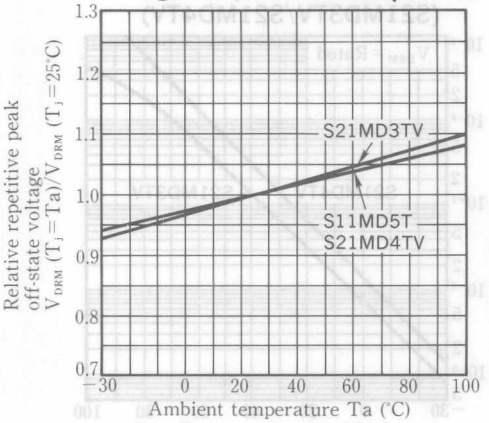


Fig. 6 On-state Voltage vs. Ambient Temperature (S11MD5T)

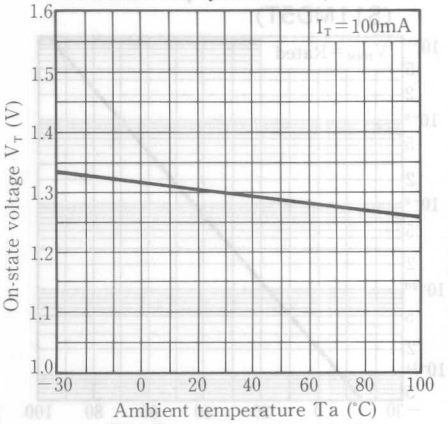


Fig. 7 On-state Voltage vs. Ambient Temperature (S21MD3TV/S21MD4TV)

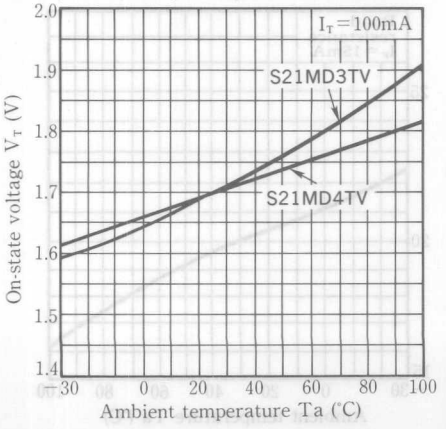
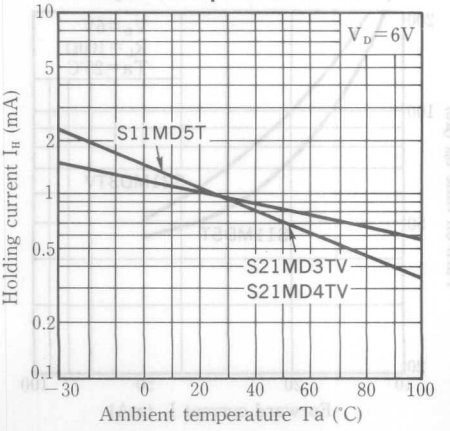


Fig. 8 Holding Current vs. Ambient Temperature



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Fig. 9 Repetitive Peak Off-state Current vs. Off-state Voltage (S11MD5T)

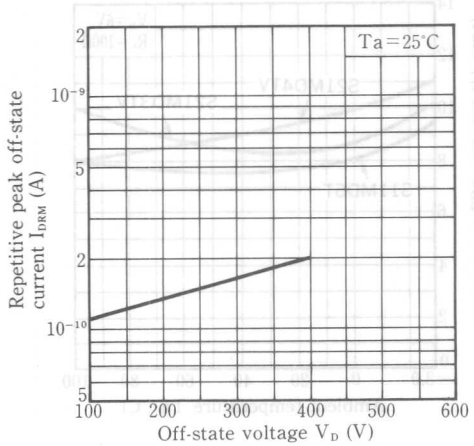


Fig. 10 Repetitive Peak Off-state Current vs. Off-state Voltage (S21MD3TV/S21MD4TV)

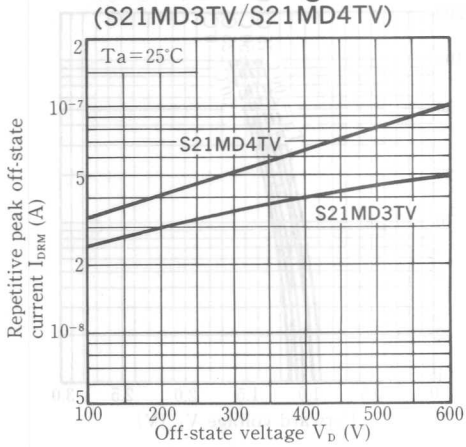


Fig. 11 Repetitive Peak Off-state Current vs. Ambient Temperature (S11MD5T)

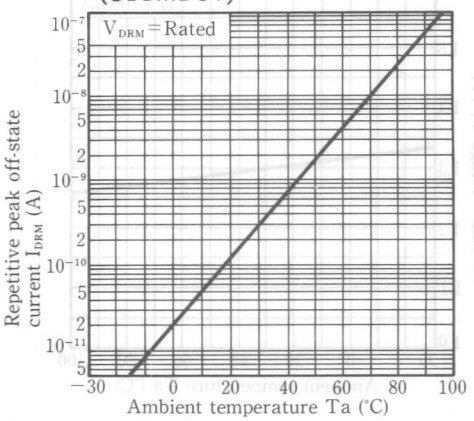


Fig. 12 Repetitive Peak Off-state Current vs. Ambient Temperature (S21MD3TV/S21MD4TV)

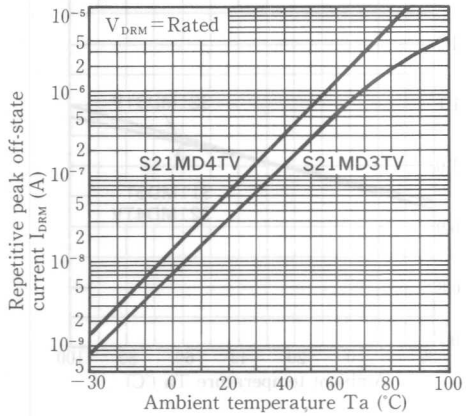


Fig. 13 Turn-on Time vs. Forward Current (S11MD5T/S21MD3TV)

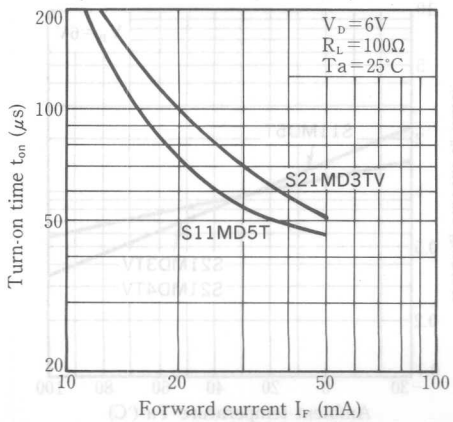


Fig. 14 Zero-cross Voltage vs. Ambient Temperature (S21MD4TV)

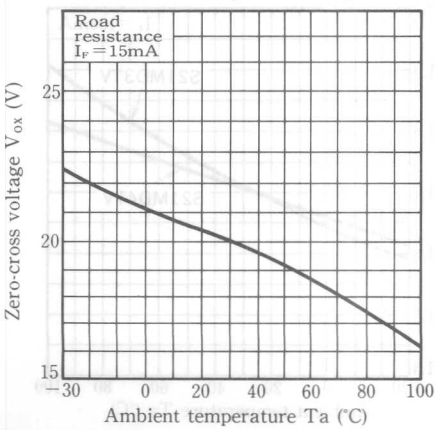
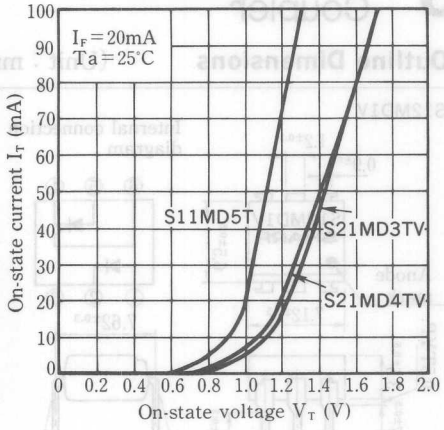


Fig. 15 On-state Current vs. On-state Voltage



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S12MD1V/S12MD3 Photothyristor Coupler

※ Lead forming type (I type) of S12MD1V is also available. (S12MD1VI) (Page 482)

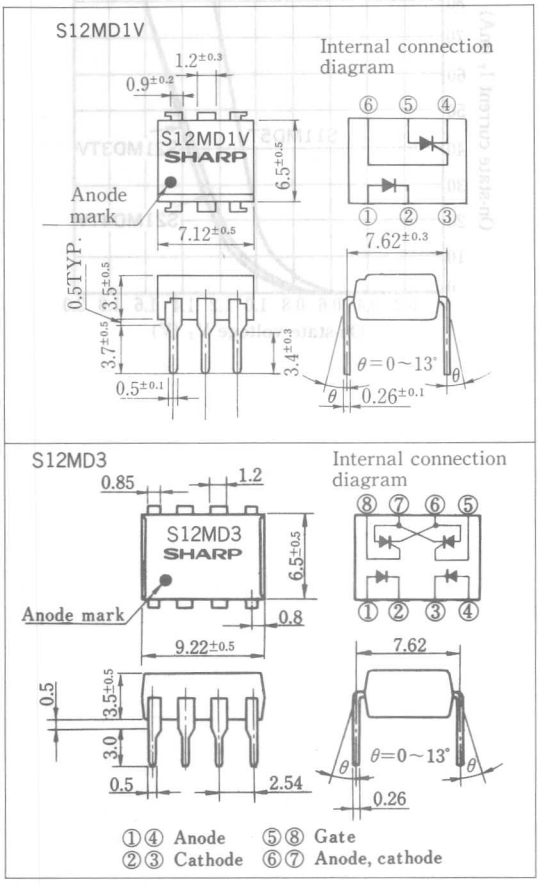
■ Features

1. High RMS on-state current (I_T : MAX. 200mArms)
2. High repetitive peak off-state voltage (V_{DRM} : MIN. 400V)
3. Trigger current I_{FT} : MAX. 15mA at R_G = 20kΩ
4. (For half-wave control···S12MD1V
   For full-wave control···S12MD3
5. UL recognized, file No. E64380

■ Applcations

1. On-off operation for a low power load
2. For triggering high power thyristor and triac

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating		Unit
			S12MD1V	S12MD3	
Input	Forward current	I_F	50	50	mA
	Reverse voltage	V_R	6	6	V
Output	RMS on-state current	I_T	200	200	mArms
	*1Peak one cycle surge current	I_{surge}	2	2	A
	*2Repetitive peak off-state voltage	V_{DRM}	400	400	V
	*2Repetitive peak reverse voltage	V_{RRM}	400	—	V
*3Isolation voltage		V_{iso}	5,000	1,500	Vrms
Operating temperature		T_{opr}	−30～+100	−30～+100	°C
Storage temperature		T_{stg}	−40～+125	−40～+125	°C
*4Soldering temperature		T_{sol}	260	260	°C

*1 50Hz, sine wave
*2 R_G=20kΩ
*3 RH=40～60%, AC for 1 minute
*4 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=30mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive peak off-state current	I_{DRM}	V_{DRM}=Rated, R_G=20kΩ	—	—	10^{-6}	A
	*5Repetitive peak reverse current	I_{RRM}	V_{RRM}=Rated, R_G=20kΩ	—	—	10^{-6}	A
	On-state voltage	V_T	I_T=200mA	—	1.0	1.4	V
	Holding current	I_H	V_D=6V, R_G=20kΩ	—	0.3	1	mA
	Cirtical rate of rise of off-state voltage	dv/dt	V_{DRM}=1/√2 Rated, R_G=20kΩ	3	—	—	V/μs
Transfer characteristics	Minimum trigger current	I_{FT}	V_D=6V, R_L=100Ω, R_G=20kΩ	—	—	15	mA
	Isolation resistance	R_{ISO}	DC 500V, RH=40%~60%	—	10^{11}	—	Ω
	Turn-on time	t_{on}	V_D=6V, I_F=30mA, R_G=20kΩ, R_L=100Ω	—	20	—	μs

*5 Applies only to S12MD1V

Fig. 1 RMS On-state Current vs. Ambient Temperature

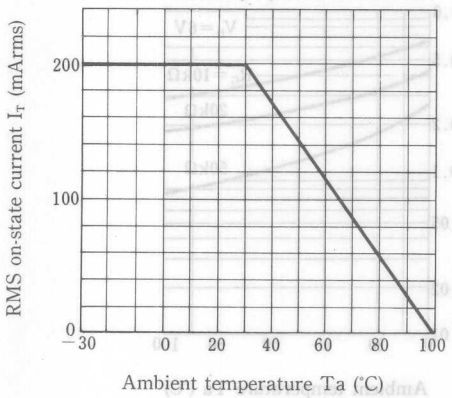


Fig. 2 Forward Current vs. Ambient Temperature

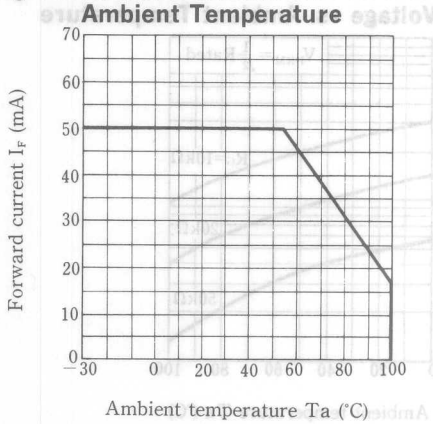


Fig. 3 Forward Current vs. Forward Voltage

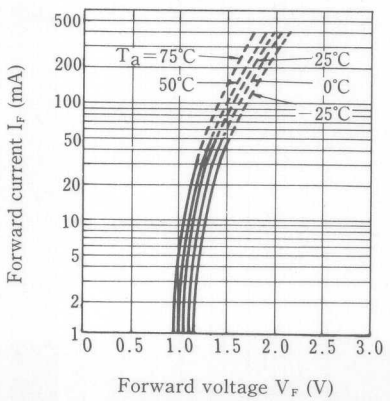
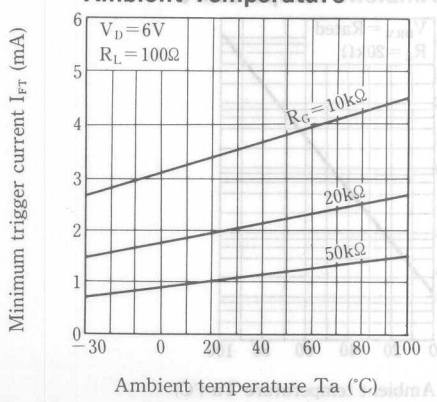


Fig. 4 Minimum Trigger Current vs. Ambient Temperature



6

Fig. 5 Minimum Trigger Current vs. Gate Resistance

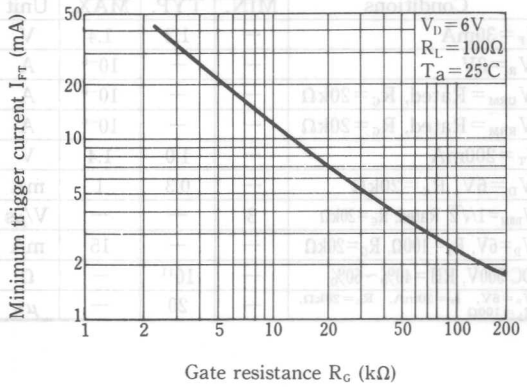


Fig. 6 Break Over Voltage vs. Ambient Temperature

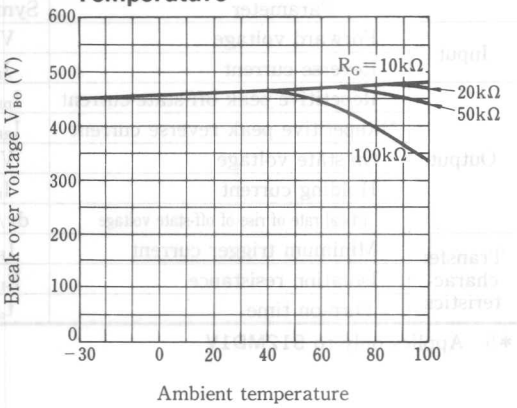


Fig. 7 Critical Rate of Rise of Off-state Voltage vs. Ambient Temperature

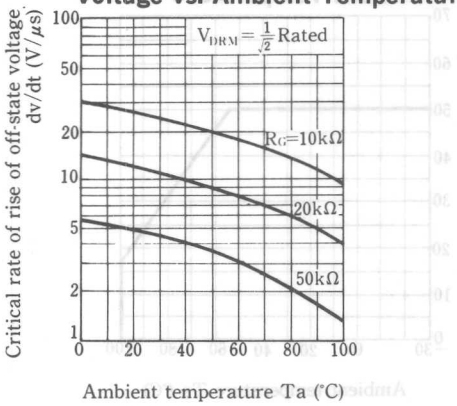


Fig. 8 Holding Current vs. Ambient Temperatuse

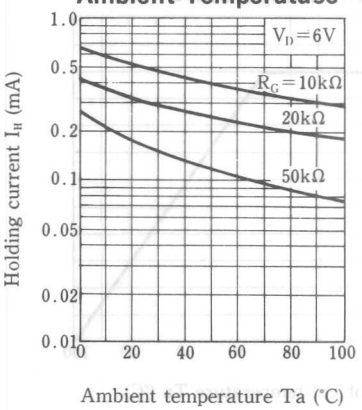
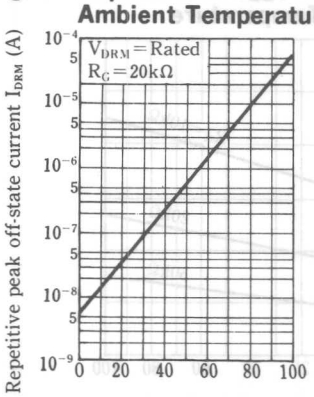


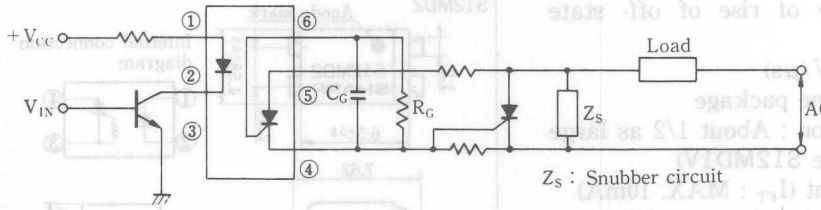
Fig. 9 Repetitive Peak Off-state Current vs. Ambient Temperature



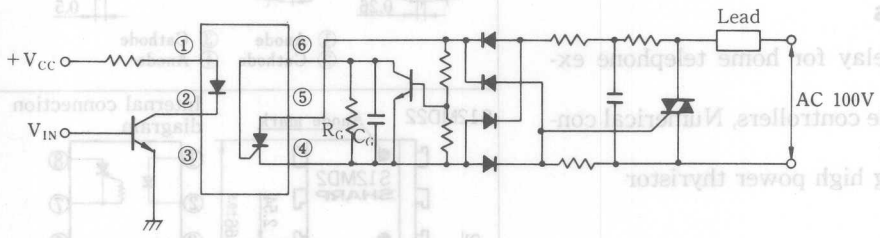
■ Basic Operation Circuit

●S12MD1V

High Power Thyristor Drive Circuit

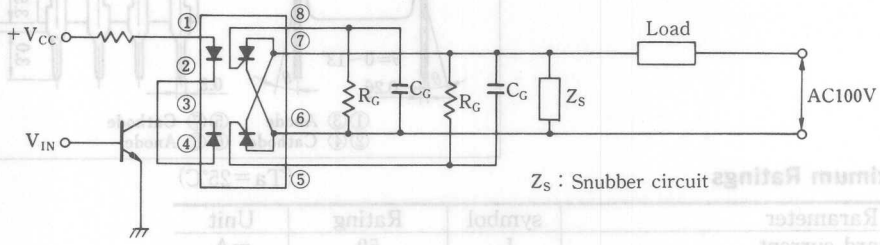


High Power Triac Drive Circuit (Zero-cross Operation)

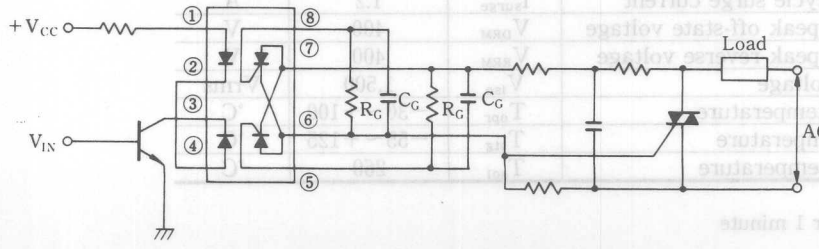


●S12MD3

Low Power Load Drive Circuit



High Power Triac Drive Circuit



6

S12MD2 Series

High Noise-reduction, High Density Mounting Type Photothyrister Coupler

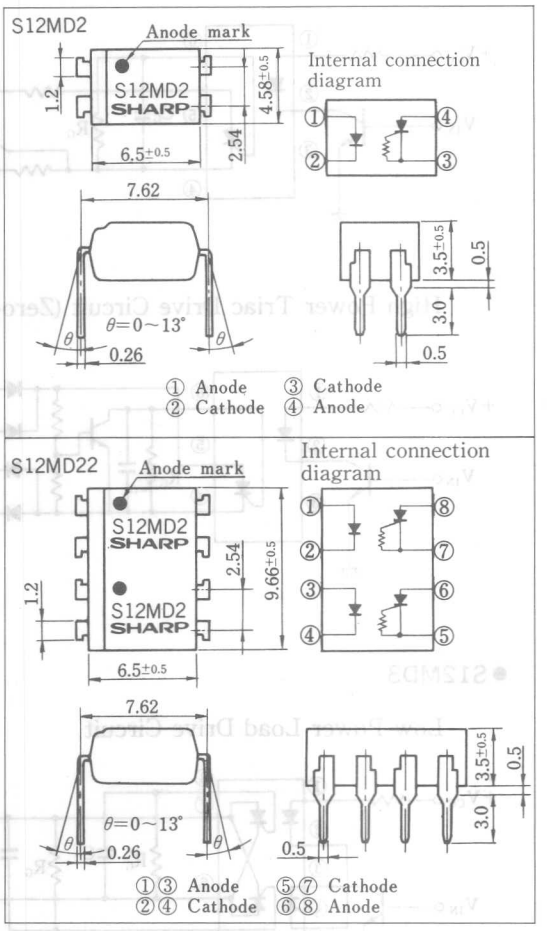
■ Features

1. High critical rate of rise of off- state voltage
   (dv/dt : MIN. 100V/μs)
2. Compact dual-in-line package
   (Volume comparison : About 1/2 as large as Sharp 6-pin type S12MD1V)
3. Low trigger current (I_{FT} : MAX. 10mA)
4. High repetitive peak off-state voltage
   (V_{DRM} : MIN. 400V)
5. UL recognized, file No. E64380

■ Applications

1. Cross-point relay for home telephone exchangers
2. Programmable controllers, Numerical control machines
3. For triggering high power thyristor

■ Outline Dimensions (Unit:mm)



■ Absolute Maximum Ratings (Ta=25°C)

Rarameter		symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
Output	RMS on-state current	I_T	200	mArms
	*1 Peak one cycle surge current	I_{surge}	1.2	A
	Repetitive peak off-state voltage	V_{DRM}	400	V
	Repetitive peak reverse voltage	V_{RRM}	400	V
*2 Isolation voltage		V_{iso}	1,500	Vrms
Opelating temperature		T_{opr}	−30~+100	°C
Storage temperature		T_{stg}	−55~+125	°C
*3 Soldering temperature		T_{sol}	260	°C

*1 50Hz, sine wave
*2 RH=40~60%, AC for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=4V	—	—	10^{-5}	A
Output	Repetitive peak off-state current	I_{DRM}	V_{DRM}=Rated	—	—	10^{-6}	A
	Repetitive peak Reverse current	I_{RRM}	V_{RRM}=Rated	—	—	10^{-6}	A
	On-state voltage	V_T	I_T=200mA	—	1.0	1.4	V
	Holding current	I_H	V_D=6V	0.1	0.5	1.0	mA
	Critical rate of rise of off-state voltage	dv/dt	$V_{DRM}=1/\sqrt{2}$ Rated	100	—	—	V/μs
Transfer characteristics	Minimum trigger current	I_{FT}	V_D=6V, R_L=100Ω	—	6.0	10	mA
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Turn-on time	t_{on}	V_D=6V, I_F=30mA, R_L=100Ω,	—	20	50	μs

Fig. 1 RMS On-state Current vs. Ambient Temperature

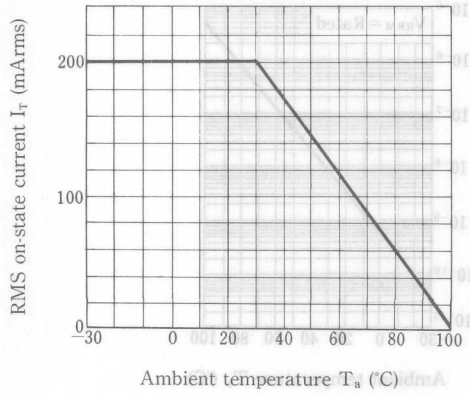


Fig. 2 Forward Current vs. Ambient Temperature

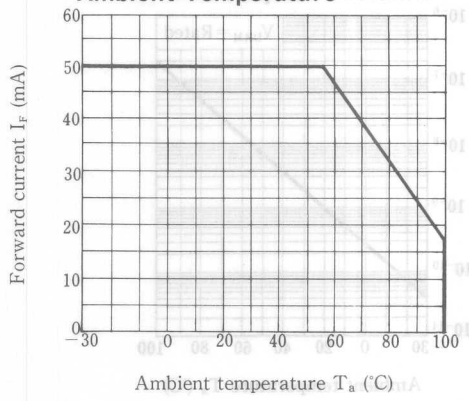


Fig. 3 Forward Current vs. Forward Voltage

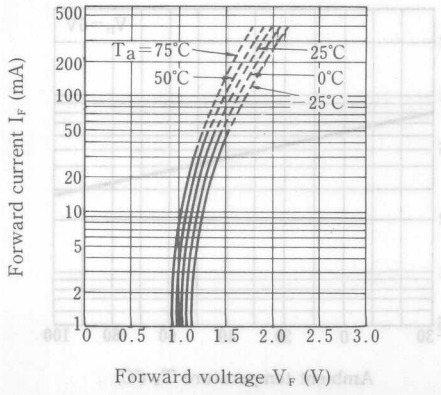
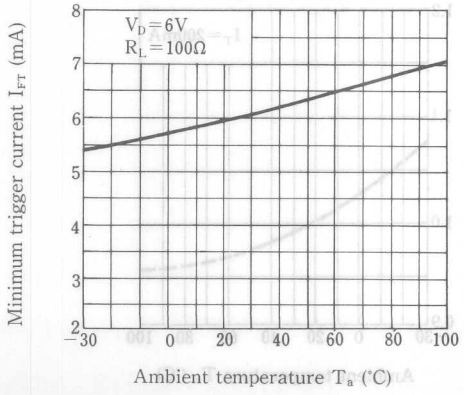


Fig. 4 Minimum Trigger Current vs. Ambient Temperature



6

Fig. 5 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature

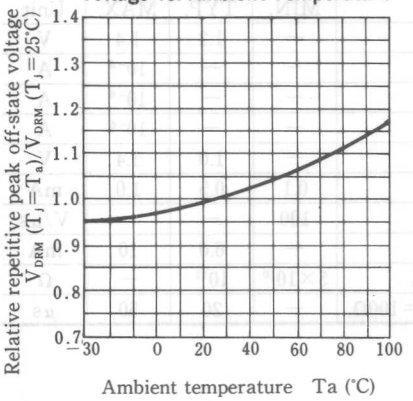


Fig. 6 Relative Repetitive Peak Reverse Voltage vs. Ambient Temperature

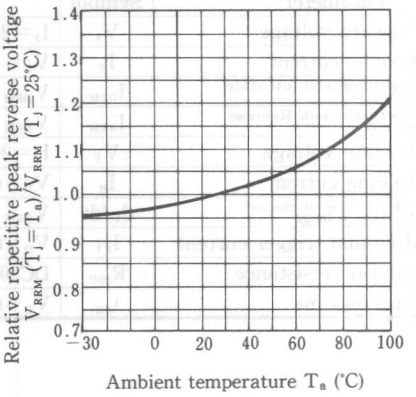


Fig. 7 Repetitive Peak Off-state Current vs. Ambient Temperature

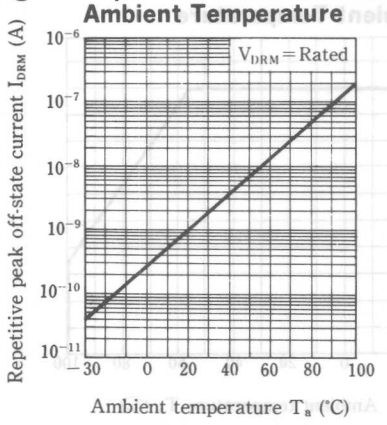


Fig. 8 Repetitive Peak Reverse Current vs. Ambient Temperature

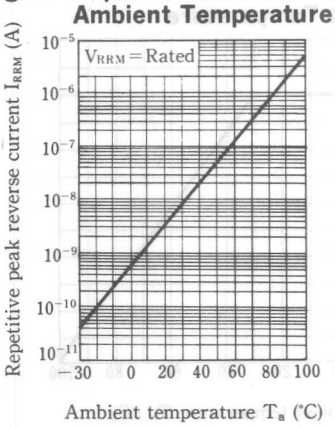


Fig. 9 On-state Voltage vs. Ambient Temperature

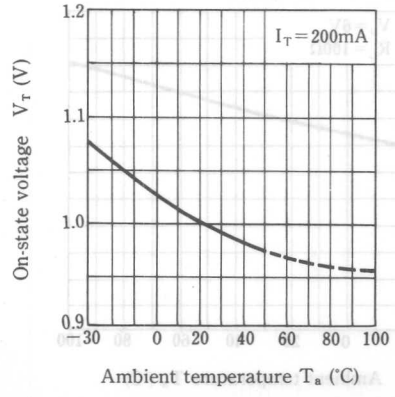


Fig. 10 Holding Current vs. Ambient Temperature

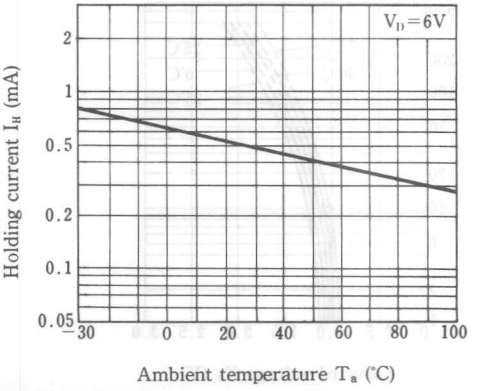


Fig. 11 On-state Current vs. On-state Voltage

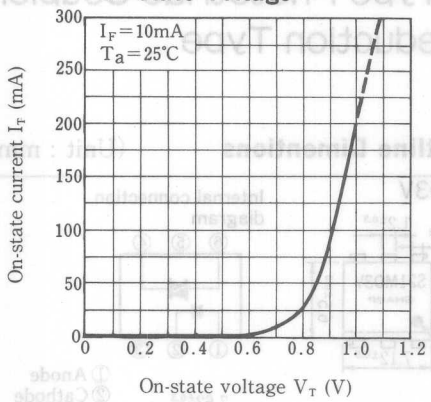
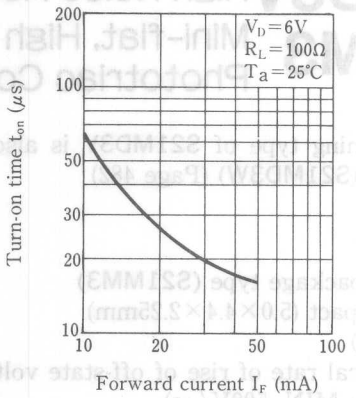
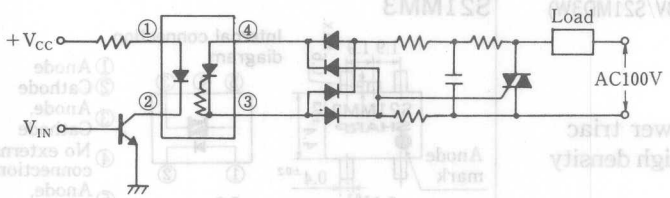


Fig. 12 Turn-on Time vs. Forward Current



■ Basic Operation Circuit

Triac Drive Circuit



6

S21MD3V High Noise Reduction Type Phototriac Coupler
S21MM3 Mini-flat, High Noise Reduction Type Phototriac Coupler

※ Lead forming type of S21MD3V is also available (S21MD3W) (Page 482)

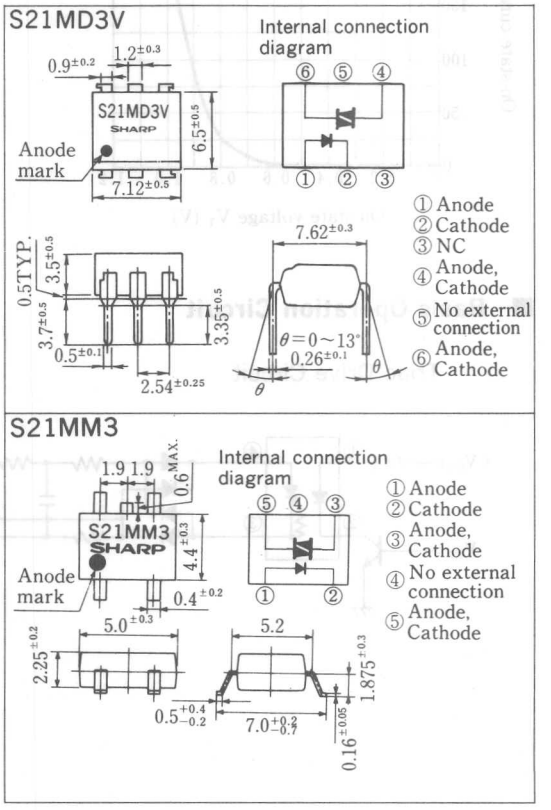
■ Features

1. Mini-flat package type (S21MM3)
2. Ultra-compact (5.0×4.4×2.25mm) (S21MM3)
3. High critical rate of rise of off-state voltage (dv/dt: MIN. 500V/μs)
4. High repetitive peak off-state voltage (V_{DRM}: MIN. 600V)
5. Isolation voltage between input and output
   V_{iso}: 5,000Vrms (S21MD3V)
   V_{iso}: 2,500Vrms (S21MM3)
6. UL recognized, file No. E64380
   TÜV approved, No. R50095 } (S21MD3V/S21MD3W)

■ Applications

1. For triggering medium/high power triac
2. Hybrid substrate that requires high density mounting (S21MM3)

■ Outline Dimentions (Unit : mm)

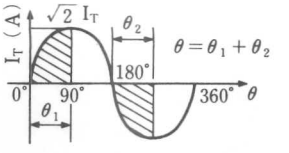


■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating S21MD3V	Rating S21MM3	Unit
Input	Forward current	I_F	50		mA
	Reverse voltage	V_R	6		V
Output	*1RMS on-state current	I_T	100		mArms
	*2Peak one cycle surge current	I_{surge}	1.2		A
	Repetitive peak off-state voltage	V_{DRM}	600		V
*3Isolation voltage		V_{iso}	5,000	2,500	Vrms
Operating temperature		T_{opr}	−30～+100		°C
Storage temperature		T_{stg}	−55～+125	−40～+125	°C
*4Soldering temperature		T_{sol}	260		°C

*1 The conductive angle θ of the RMS on-state current I_T shall satisfy the relation as follows: (S21MM3)
θ (conductive angle) = $\theta_1 + \theta_2 \leqq 180°$
For the definition, see the figure on the right.
For the derating curve, see Fig. 1.

*2 Sine wave
*3 RH=40～60%, AC for 1 minute
*4 For 10 seconds

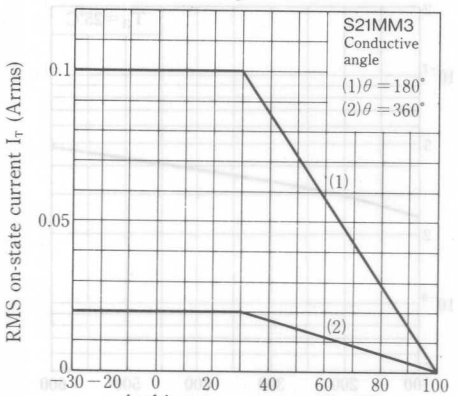


■ Eletro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=30mA(S21MD3V), I_F=20mA (S21MM3)	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive peak off-state current	I_{DRM}	V_{DRM}=Rated	—	—	10^{-6}	A
	On-state voltage	V_T	I_T=100mA	—	1.7	2.5	V
	Holding current	I_H	V_D=6V	0.1	1	3.5	mA
	Critical rate of rise of off-state voltage	dv/dt	$V_{DRM}=1/\sqrt{2}$ Rated	500	—	—	V/μs
Transfer chrac-teristics	Minimum trigger current	I_{FT}	V_D=6V, R_L=100Ω	—	—	15	mA
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Turn-on time	t_{on}	V_D=6V, I_F=30mA, R_L=100Ω	—	100	250	μs

(Note) Measurement of each characteristics shall be carried out in opaque condition.

Fig. 1 RMS On-state Current vs.* Ambient Tamperature



※See the graph (1) for the S21MD3V regardless of the conductive angle θ.

Fig. 2 Forward Current vs. Ambient Temperature

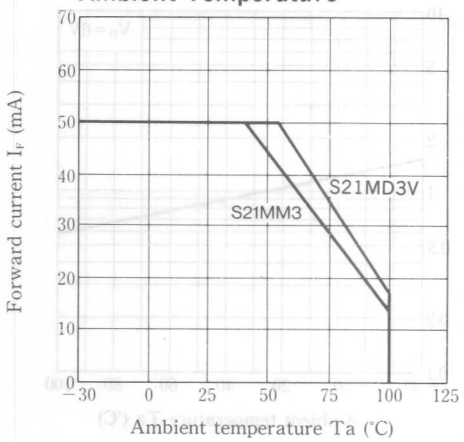


Fig. 3 Forward Current vs. Forward Voltage

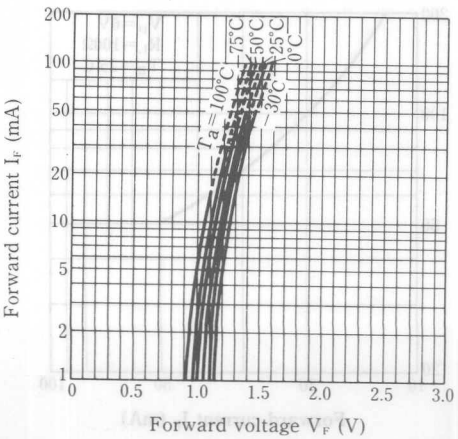
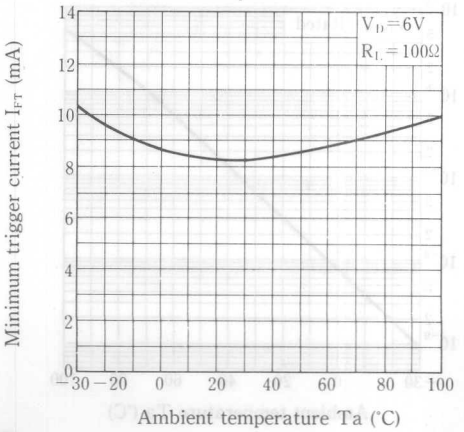


Fig. 4 Minimum Trigger Current vs. Ambient Temparature



6

Fig. 5 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature

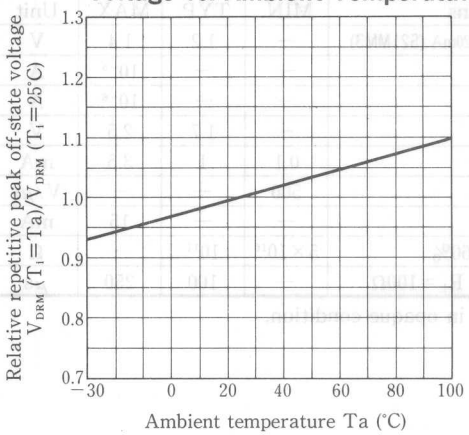


Fig. 6 On-state Voltage vs. Ambient Temperature

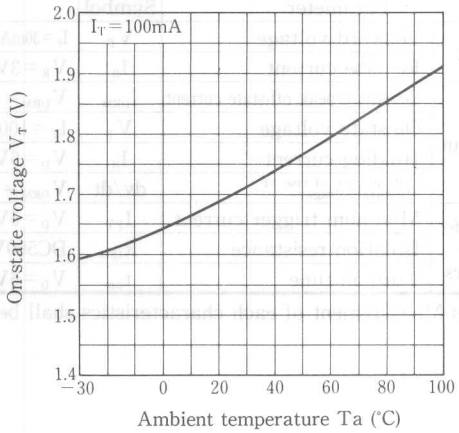


Fig. 7 Holding Current vs. Ambient Temperature

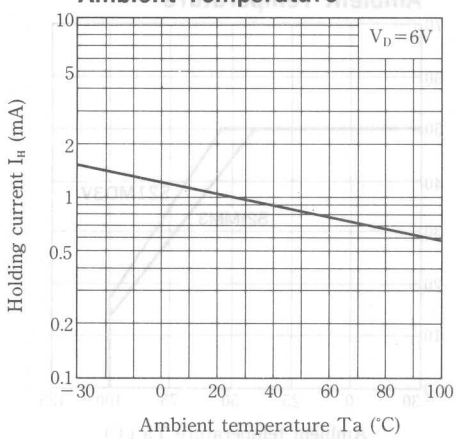


Fig. 8 Repetitive Peak Off-state Current vs. Off-state Voltage

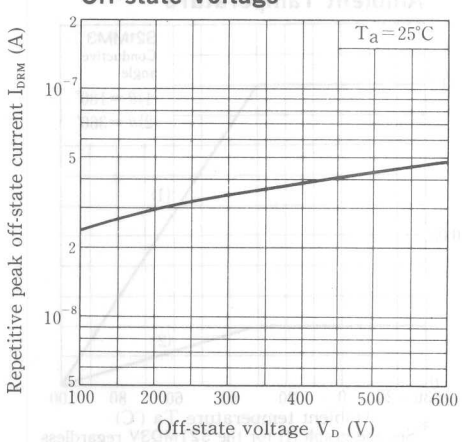


Fig. 9 Repetitive Peak Off-state Current vs. Ambient Temparature

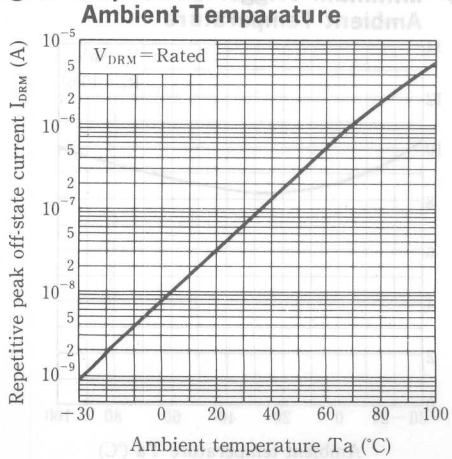


Fig. 10 Turn-on Time vs. Forward Current

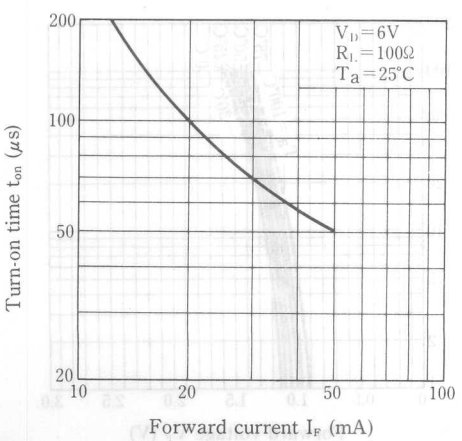
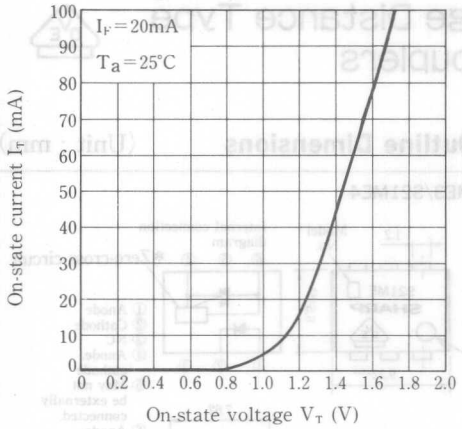


Fig. 11 On-state Current vs. On-state Voltage



■ Precautions for Use (S21MM3)

1. Shielding lights
   Shield the phototriac coupler from external disturbing lights as by remolding it with opaque resin. Failure to do so may result in faulty operation due to intense external disturbing lights.
2. Remolding
   This product is packaged in epoxy-based resin. Therefore, use an epoxy-based resin with its hardening temperature of less than 150°C and hardening time of less than 2 hours when remolding.
3. Humidity resistance
   This product is designed to be remolded for hybrid applications. So refer to the reliability requirements given in the specifications for humidity resistance if you don't remold it.

6

S21ME Series

European Safety Standard Approved, Long Creepage Distance Type Phototriac Couplers

■ Features

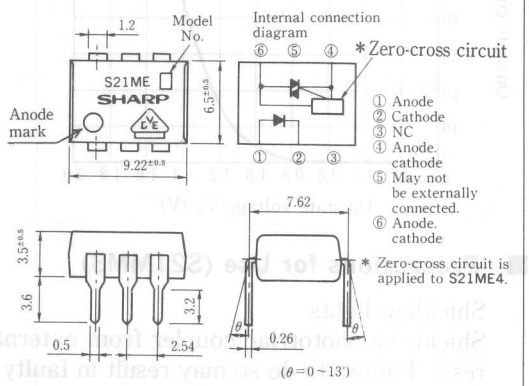
1. Long creepage distance type
   (Creepage distance: 8mm or more)
2. Internal insulation distance: 0.5mm or more
3. Description of approved safety standards
   (Lead forming type is also registered as S21ME3/S21ME4.)
   UL 1577 (double protection included) recognized, file No. E64380
   VDE 0883 approved, No. 47797
   BS 415 approved, No. 6690
   SEMKO approved,
   S21MEC/S21ME3F No. 8705122
   S21ME4/S21ME4F No. 8705123
   DEMKO approved, No. 37123
   EI approved,
   S21ME3/S21ME3F No. 099443-01
   S21ME4/S21ME4F No. 099444-01
4. Low minimum trigger current
   (I_{FT}: MAX. 7mA)
5. Built-in zero-cross circuit
   (S21ME4/S21ME4F)
6. Lead forming type/S21ME3F, S21ME4F
   (Distance between lead pins: 10.16mm)
7. High repetitive peak off-state voltage
   (V_{DRM}: MIN. 600V)
8. High input-output isolation voltage
   (V_{iso}: 5,000Vrms)

■ Applications

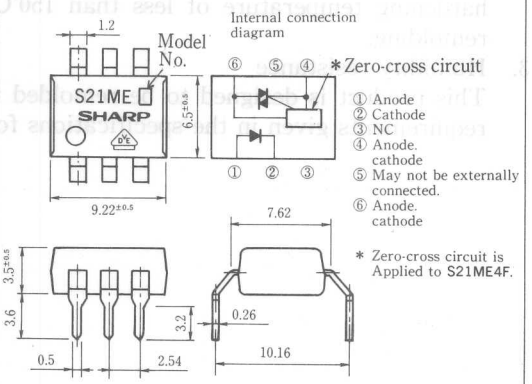
1. For triggering medium/high power triac

■ Outline Dimensions (Unit : mm)

S21ME3/S21ME4



S21ME3F/S21ME4F



The S21ME3F and S21ME4F are marked S21ME3 SHARP and S21ME4 SHARP

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
Output	RMS on-state current	I_T	100	mArms
	*1Peak one cycle surge current	I_{surge}	1.2	A
	Repetitive peak off-state voltage	V_{DRM}	600	V
*2Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30～+100	°C
Storage temperature		T_{stg}	−55～+125	°C
*3Soldering temperature		T_{sol}	260	°C

*1 50Hz, sine wave
*2 RH=40～60%, AC 60Hz for 1 minute
*3 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive peak off-state current		I_{DRM}	V_{DRM}=Rated	—	—	10^{-6}	A
	On-state voltage		V_T	I_T=100mA	—	1.7	3.0	V
	Holding current		I_H	V_D=6V	0.05	—	3.5	mA
	Critical rate of rise of off-state voltage	S21ME3 S21ME3F	dv/dt	$V_{DRM}=1/\sqrt{2}$ Rated	500	—	—	V/μs
		S21ME4 S21ME4F			100	—	—	
	Zero-cross voltage	S21ME4 S21ME4F	V_{OX}	Load resistance, I_F=15mA	—	—	35	V
Transfer characteristics	Minimum trigger current		I_{FT}	V_D=6V, R_L=100Ω	—	—	7.0	mA
	Isolation resistance		R_{ISO}	DC500V, RH=40～60%	5×10^{10}	10^{11}	—	Ω
	Turn on time	S21ME3 S21ME3F	t_{on}	V_D=6V, R_L=100Ω, I_F=20mA	—	40	100	μs
		S21ME4 S21ME4F		f=50Hz	—	—	1/2	cycle
	Turn off time	S21ME4 S21ME4F	t_{off}	f=50Hz	—	—	1/2	cycle

Fig. 1 RMS On-state Current vs. Ambient Temperature

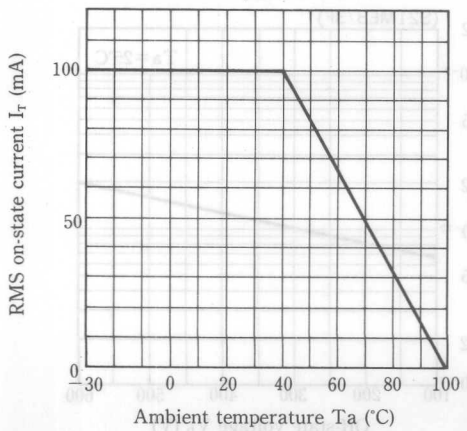
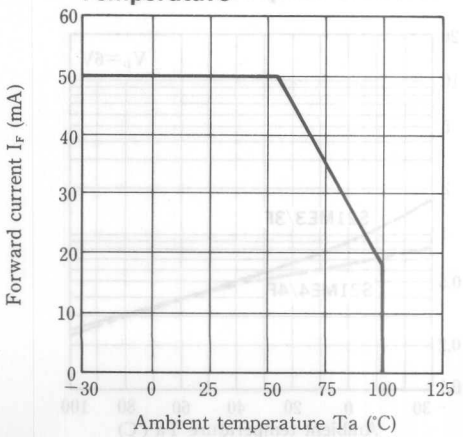


Fig. 2 Forward Current vs. Ambient Temperature



6

Fig. 3 Forward Current vs. Forward Voltage

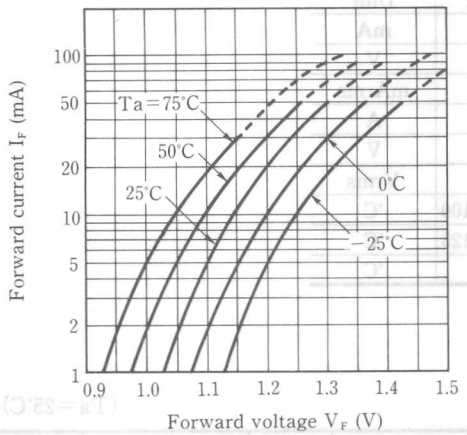


Fig. 4 Minimum Trigger Current vs. Ambient Temperature

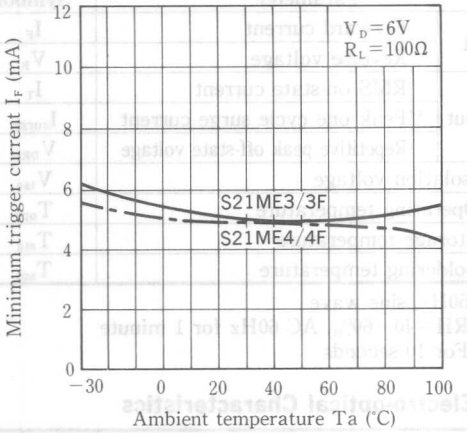


Fig. 5 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature

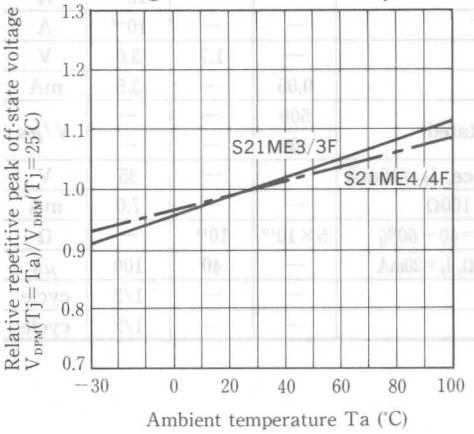


Fig. 6 On-state Voltage vs. Ambient Temperature

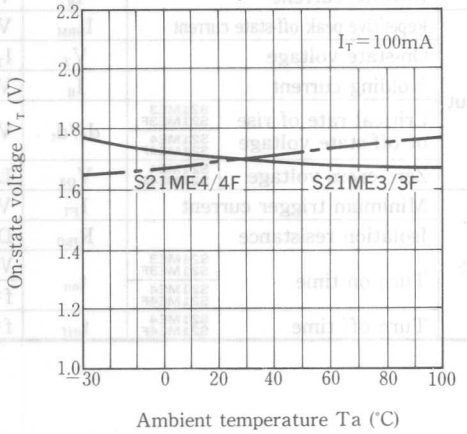


Fig. 7 Holding Current vs. Ambient Temperature

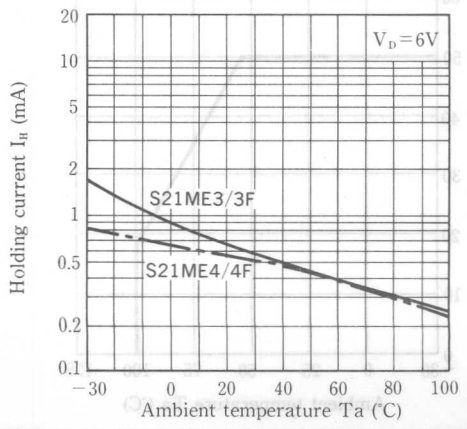


Fig. 8 Repetitive Peak Off-state Current vs. Off-state Voltage

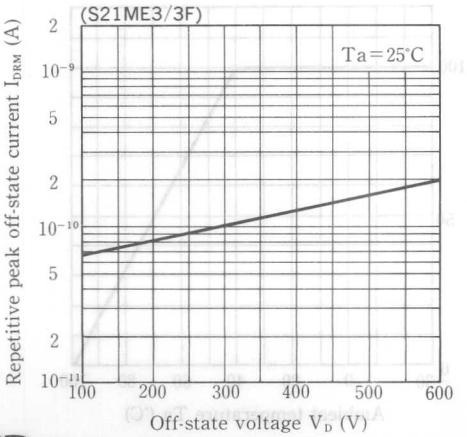


Fig. 9 Repetitive Peak Off-state Current vs. Off-state Voltage

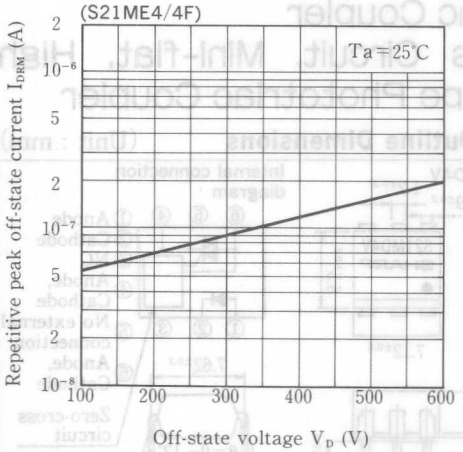


Fig. 10 Repetitive Peak Off-state Current vs. Ambient Temperature

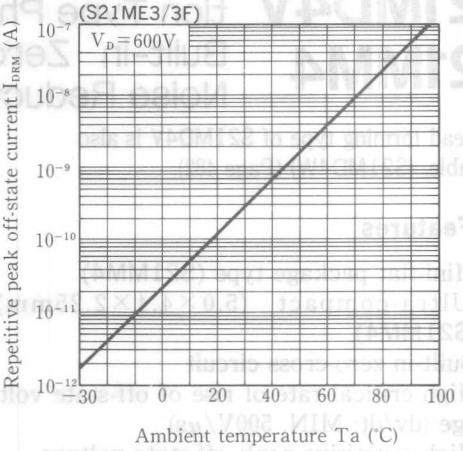


Fig. 11 Repetitive Peak Off-state Current vs. Ambient Temperature

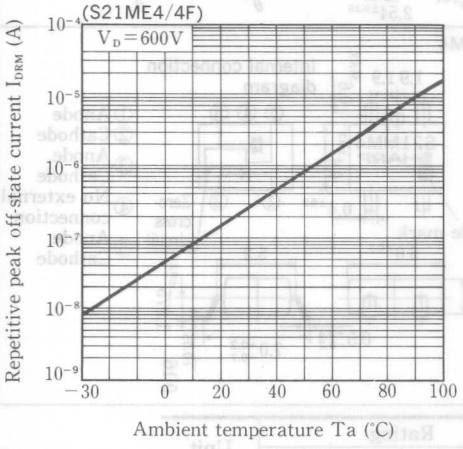


Fig. 12 Turn-on Time vs. Forward Current

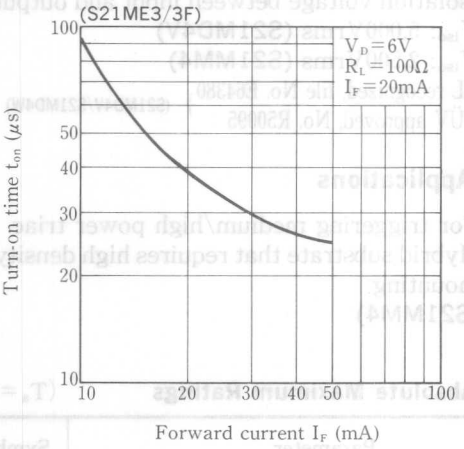


Fig. 13 Zero-cross Voltage vs. Ambient Temperature

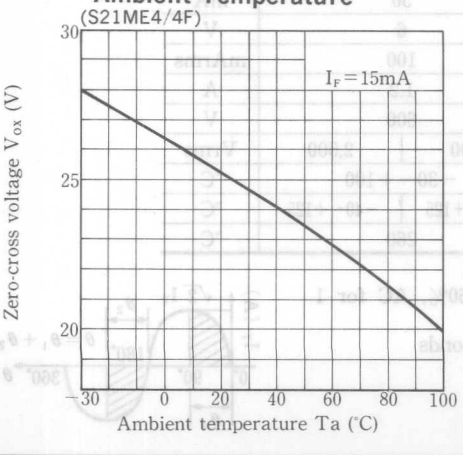
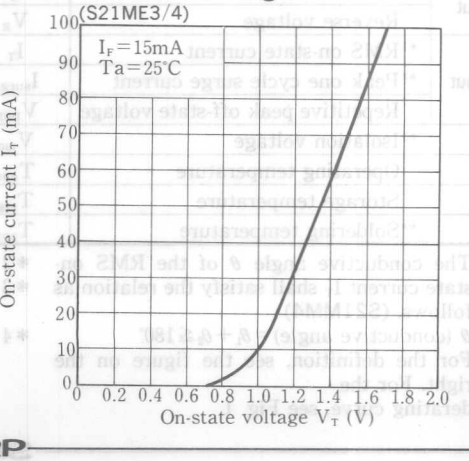


Fig. 14 On-state Current vs. On-state Voltage



6

S21MD4V S21MM4

Built-in Zero-cross Circuit, High Noise Reduction Type Phototriac Coupler
Built-in Zero-cross Circuit, Mini-flat, High Noise Reduction Type Phototriac Coupler

※ Lead forming type of S21MD4V is also available. (S21MD4W) (Page 482)

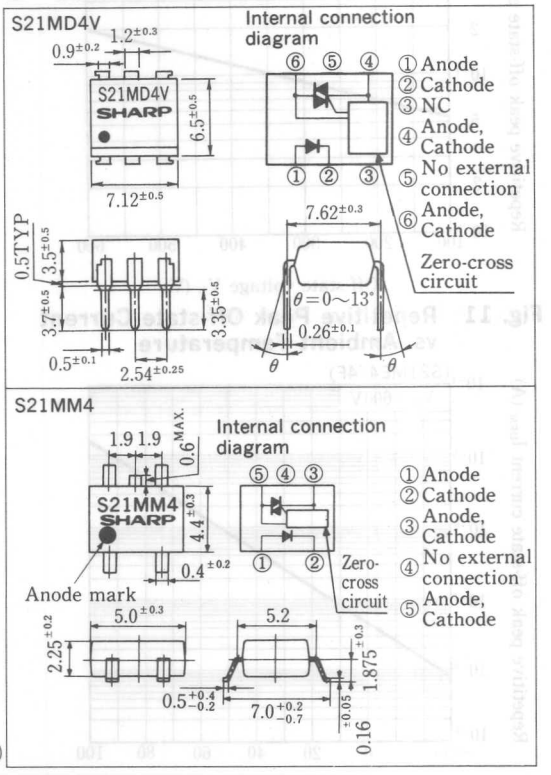
■ Features

1. Mini-flat package type (S21MM4)
2. Ultra-compact (5.0×4.4×2.25mm) (S21MM4)
3. Built-in zero-cross circuit
4. High critical rate of rise of off-state voltage (dv/dt: MIN. 500V/μs)
5. High repetitive peak off-state voltage (V_{DRM}: MIN. 600V)
6. Isolation voltage between input and output
   V_{iso}: 5,000Vrms (S21MD4V)
   V_{iso}: 2,500Vrms (S21MM4)
7. UL recognized, file No. E64380
   TÜV approved, No. R50095 } (S21MD4V/S21MD4W)

■ Applications

1. For triggering medium/high power triac
2. Hybrid substrate that requires high density mounting (S21MM4)

■ Outline Dimensions (Unit : mm)

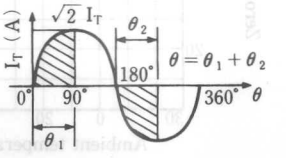


■ Absolute Maximum Ratings (T_a=25°C)

Parameter		Symbol	Rating		Unit
			S21MD4V	S21MM4	
Input	Forward current	I_F	50		mA
	Reverse voltage	V_R	6		V
Output	*1RMS on-state current	I_T	100		mArms
	*2Peak one cycle surge current	I_{surge}	1.2		A
	Repetitive peak off-state voltage	V_{DRM}	600		V
*3Isolation voltage		V_{iso}	5,000	2,500	Vrms
Operating temperature		T_{opr}	−30~+100		°C
Storage temperature		T_{stg}	−55~+125	−40~+125	°C
*4Soldering temperature		T_{sol}	260		°C

*1 The conductive angle θ of the RMS on-state current I_T shall satisfy the relation as follows. (S21MM4)
θ (conductive angle) = $\theta_1 + \theta_2 \leqq 180°$
For the definition, see the figure on the right. For the derating curve, see Fig. 1.

*2 Sine wave
*3 RH=40~60%, AC for 1 minute
*4 For 10 seconds



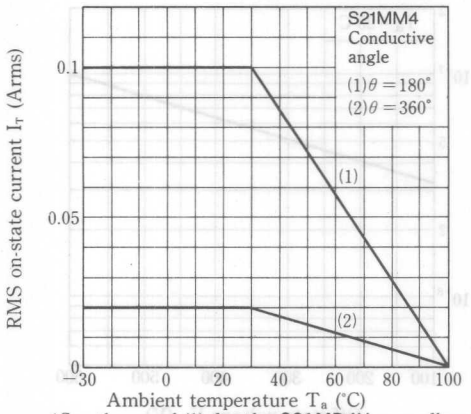
■ Electro-optical Characteristics

(T_a=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive peak off-state current	I_{DRM}	V_{DRM}=Rated	—	—	10^{-6}	A
	On-state voltage	V_T	I_T=100mA	—	1.7	2.5	V
	Holding current	I_H	V_D=6V	0.1	1	3.5	mA
	Critical rate of rise of off-state voltage	dv/dt	$V_{DRM}=1/\sqrt{2}$ Rated	100	—	—	V/μs
	Zero-cross voltage	V_{OX}	Load resistance, I_F=Rated I_{FT}	—	—	35	V
Transfer characteristics	Minimum trigger current	I_{FT}	V_D=6V, R_L=100Ω	—	—	15	mA
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Turn-on time	t_{on}	f=50Hz, 60Hz	—	—	1/2	cycle
	Turn-off time	t_{off}	t=50Hz, 60Hz	—	—	1/2	cycle

(Note) Measurement of each characteristics shall be carried out in opaque condition.

Fig. 1 RMS ON-state Current vs. Ambient Temperature*



*See the graph(1) for the S21MD4V regardless of the conductive angle θ.

Fig. 2 Forward Current vs. Ambient Temperature

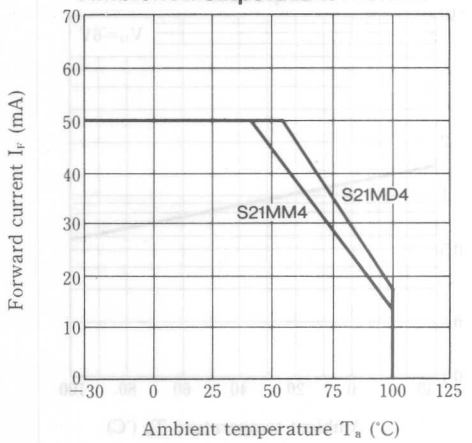


Fig. 3 Forward Current vs. Forward Voltage

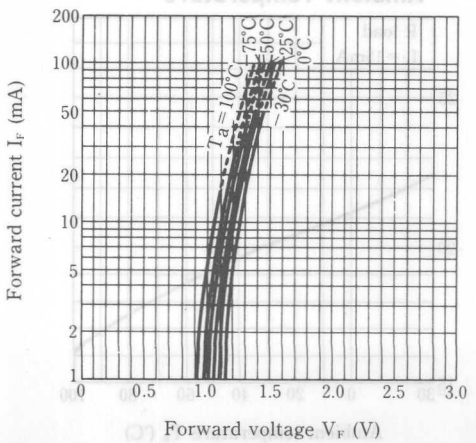
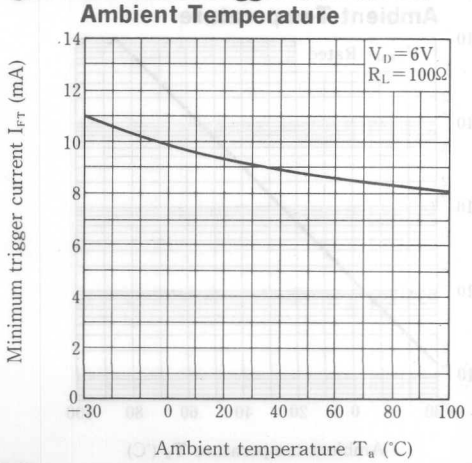


Fig. 4 Minimum Trigger Current vs. Ambient Temperature



6

Fig. 5 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature

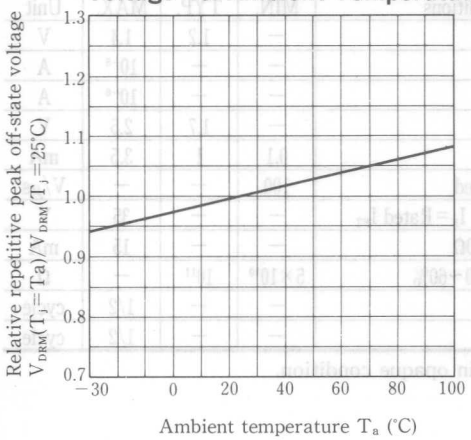


Fig. 6 On-state Voltage vs. Ambient Temperature

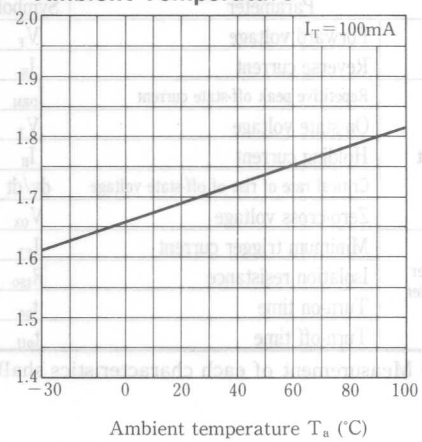


Fig. 7 Holding Current vs. Ambient Temperature

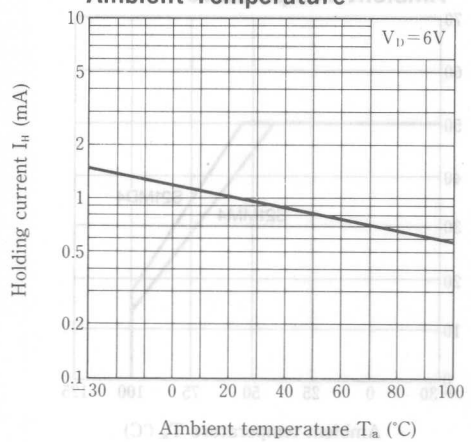


Fig. 8 Repetitive Peak Off-state Current vs. Off-state voltage

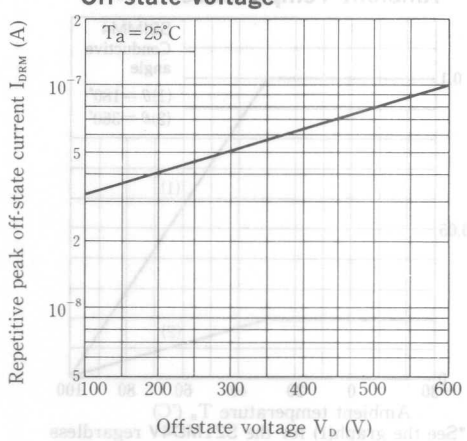


Fig. 9 Relative Peak Off-state Current vs. Ambient Temperature

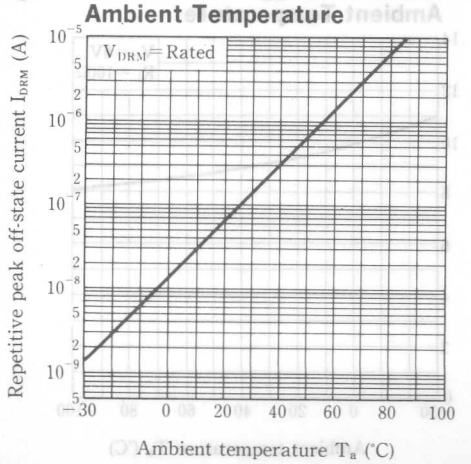


Fig. 10 Zero-cross Voltage vs. Ambient Temperature

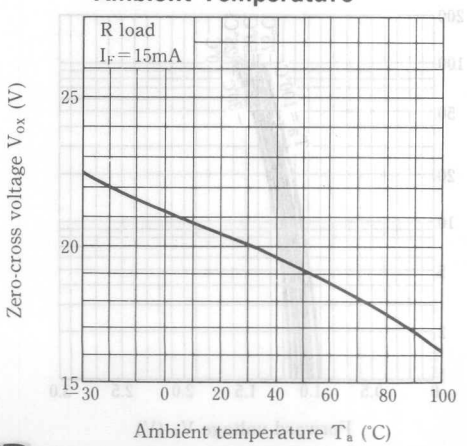
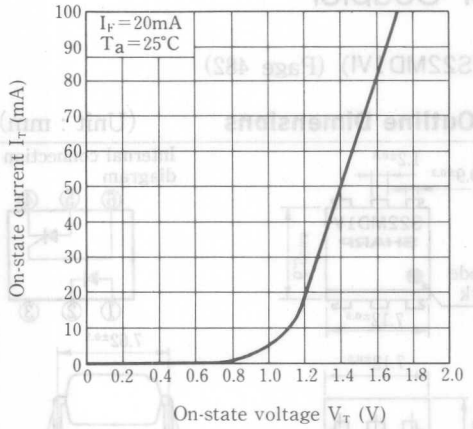


Fig. 11 On-state Current vs. On-state Voltage



■ Precautions for Use (S21MM4)

1. Shielding lights
   Shield the phototriac coupler from external disturbing lights as by remolding it with opaque resin. Failure to do so may result in faulty operation due to intense external disturbing lights.
2. Remolding
   This product is packaged in epoxy-based resin. Therefore use an epoxy-based resin with its hardening temperature of less than 150°C and hardening time of less than 2 hours when remolding.
3. Humidity resistance
   This product is designed to be remolded for hybrid applications. So refer to the reliability requirements given in the specifications for humidity resistance if you don't remold it.

6

S22MD1V Photothyristor Coupler

※ Lead forming type of S22MD1V is also available (S22MD1VI) (Page 482)

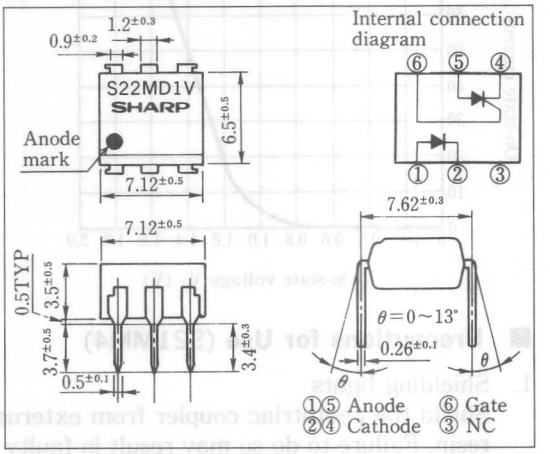
■ Features

1. High repetitive peak off-state voltage (V_{DRM} : MAX. 600V)
2. Low trigger current (I_{FT} : MAX. 10mA at R_G=20kΩ)
3. High isolation voltage between input and output V_{iso} : 5,000Vrms
4. UL recognized, file No. E64380
   TÜV approved, No. R40003

■ Applications

1. On-off operation for a low power load
2. For triggering high power thyristor and triac

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
Output	RMS on-state current	I_T	200	mArms
	*1 Peak one cycle surge current	I_{surge}	2	A
	*2 Repetitive peak off-state voltage	V_{DRM}	600	V
	*2 Repetitive peak reverse voltage	V_{RRM}	600	V
*3 Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30~+100	°C
Storage temperature		T_{stg}	−40~+125	°C
*4 Soldering temperature		T_{sol}	260	°C

*1 50Hz, sine wave
*2 R_G=20kΩ
*3 RH=40~60%, AC for 1 minute
*4 For 10 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=30mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive peak off-state current	I_{DRM}	V_{DRM}=Rated, R_G=20kΩ	—	—	10^{-6}	A
	On-state voltage	V_T	I_T=200mA	—	1.0	1.4	V
	Holding current	I_H	V_D=6V, R_G=20kΩ	—	0.2	1	mA
	Critical rate of rise of off-state voltage	dv/dt	$V_{DRM}=1/\sqrt{2}$ Rated, R_G=20kΩ	5	—	—	V/μs
	Repetitive peak reverse current	I_{RRM}	V_{RRM}=Rated, R_G=20kΩ	—	—	10^{-6}	A
Transfer characteristics	Minimum trigger current	I_{FT}	V_D=6V, R_L=100Ω, R_G=20kΩ	—		10	mA
	Isolation resistance	R_{ISO}	DC 500V, RH=40~60%	—	10^{11}	—	Ω
	Turn-on time	t_{on}	V_D=6V,R_G=20kΩ,R_L=100Ω,I_F=30mA	—	20	—	μs

Fig.1 RMS On-state Current vs. Ambient Temperature

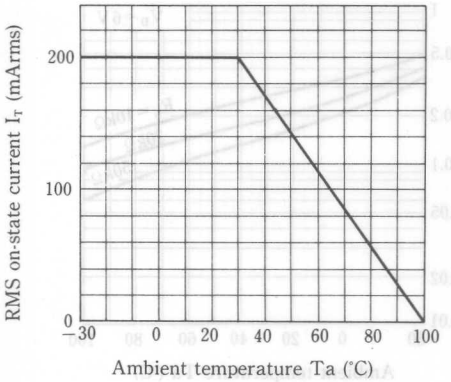


Fig.2 Forward Current vs. Ambient Temperature

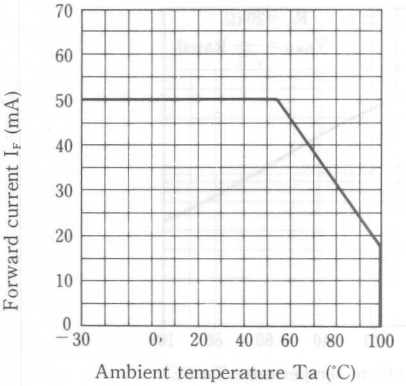


Fig.3 Forward Current vs. Forward Voltage

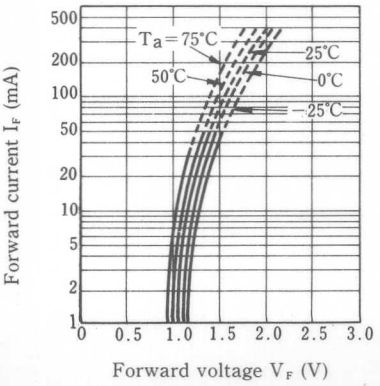
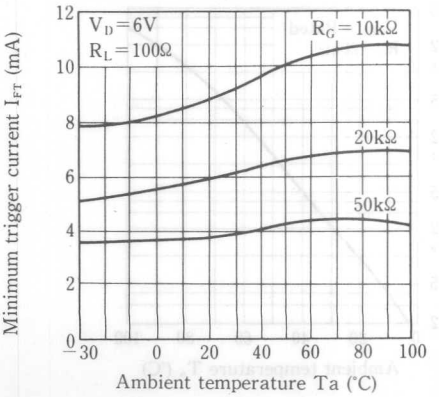


Fig.4 Minimum Trigger Current vs. Ambient Temperature



6

Fig.5 Minimum Trigger Current vs. Gate Resistance

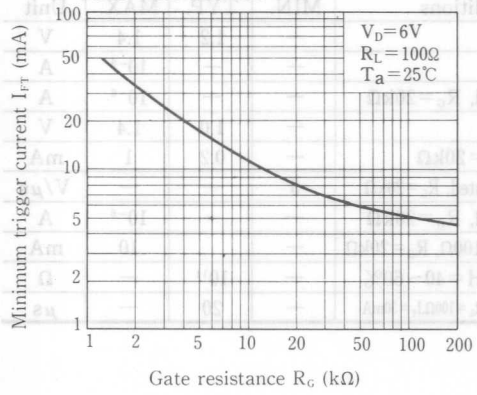


Fig.6 Break Over Voltage vs. Ambient Temperature

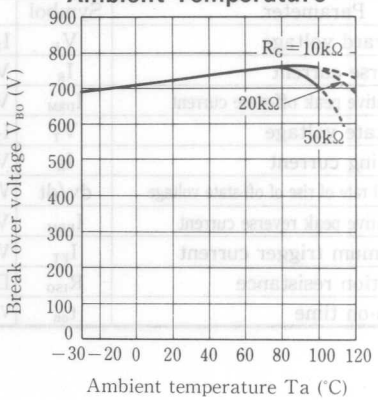


Fig.7 Critical Rate of Rise of Off-state Voltage vs. Ambient Temperature

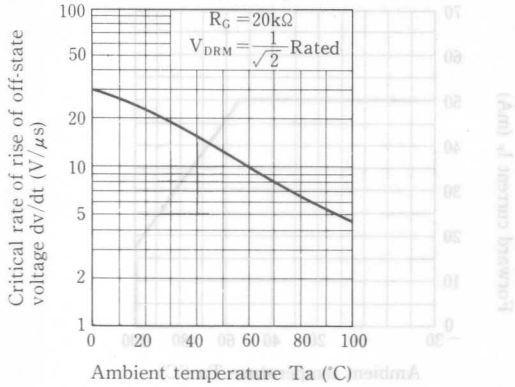


Fig.8 Holding Current vs. Ambient Temperature

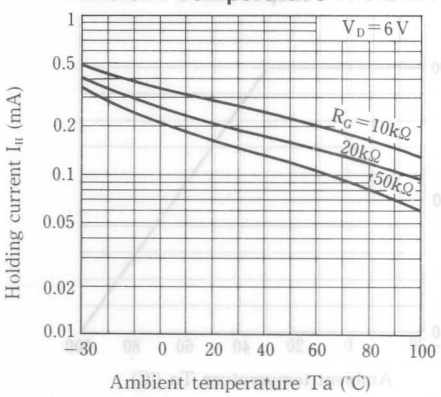
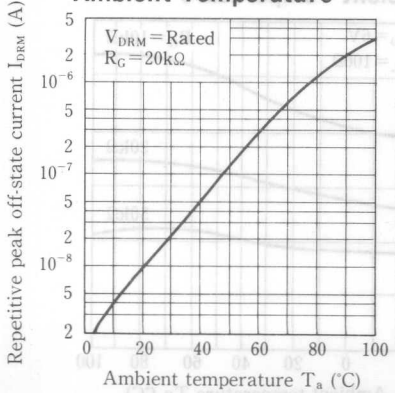
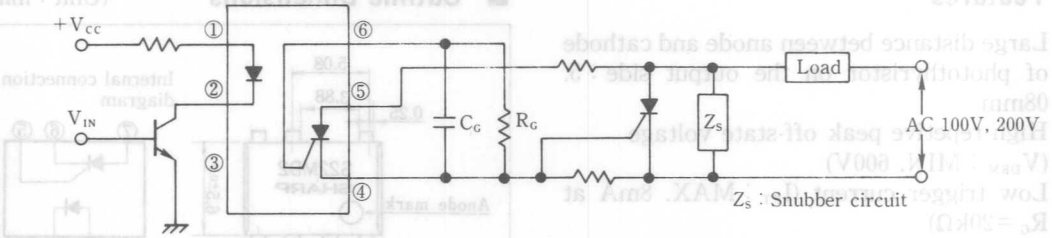


Fig.9 Repetitive Peak Off-state Current vs. Ambient Temperature

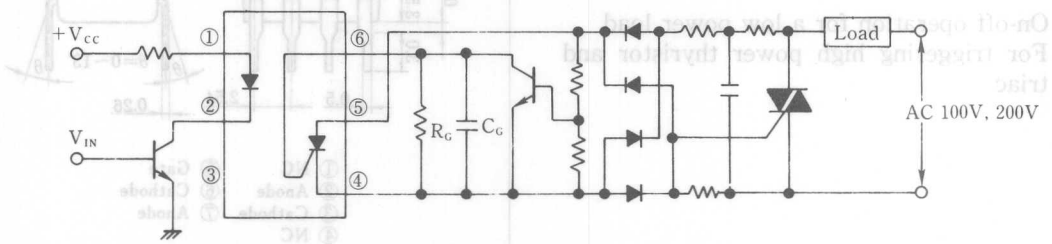


■ Basic Operation Circuit

High Power Thyristor Drive Circuit



High Power Triac Drive Circuit (Zero-cross Operation)



6

S22MD2 Photothyristor Coupler

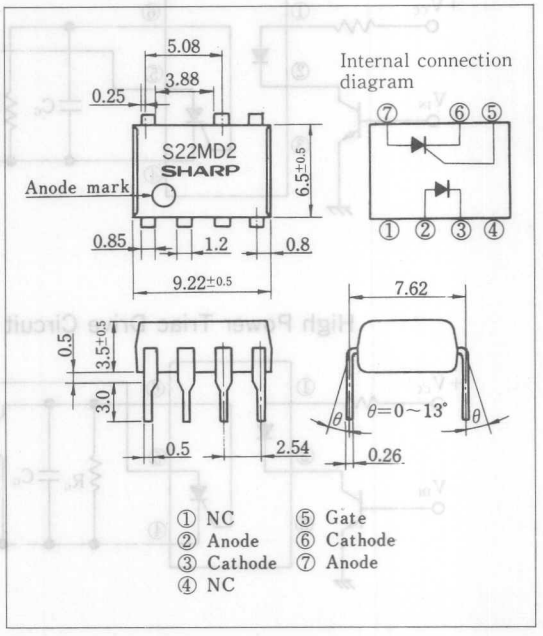
■ Features

1. Large distance between anode and cathode of photothyristor on the output side : 5.08mm
2. High repetive peak off-state voltage (V_{DRM} : MIN. 600V)
3. Low trigger current (I_{FT} : MAX. 8mA at $R_G = 20k\Omega$)
4. High input-output isolation voltage (V_{iso} : 5,000Vrms)

■ Applacations

1. On-off operation for a low power load
2. For triggering high power thyristor and triac

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
Output	RMS on-state current	I_T	200	mArms
	*1Peak one cycle surge current	I_{surge}	2	A
	*2Repetitive peak off-state voltage	V_{DRM}	600	V
	*2Repetitive peak rjverse voltage	V_{RRM}	600	V
*3Isolation voltage		V_{iso}	5,000	Vrms
Operating temperature		T_{opr}	−30~+100	°C
Storage temperature		T_{stg}	−40~+125	°C
*4Soldering temperature		T_{sol}	260	°C

*1 50Hz, sine wave
*2 $R_G = 20k\Omega$
*3 RH=40~60%, AC for 1 minute
*4 For 10 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=30mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10^{-4}	A
Output	Repetitive peak off-state current	I_{DRM}	V_{DRM}=Rated, R_G=20kΩ	—	—	10^{-6}	A
	On-state voltage	I_{RRM}	V_{RRM}=Rated, R_G=20kΩ	—	—	10^{-6}	A
	On-state voltage	V_T	I_T=200mA	—	1.0	1.4	V
	Holding current	I_H	V_D=6V, R_G=20kΩ	—	0.3	1	mA
	Critical rate of rise of off-state voltage	dv/dt	$V_{DRM}=1/\sqrt{2}$ Rated, R_G=20kΩ	3	—	—	V/μs
Transfer characteristics	Minimum trigger current	I_{FT}	V_D=6V, R_L=100Ω, R_G=20kΩ	—	6	8	mA
	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Turn-on time	t_{on}	V_D=6V, R_G=20kΩ, R_L=1000Ω, I_F=30mA	—	20	50	μs

Fig. 1 RMS On-state Current vs. Ambient Temperature

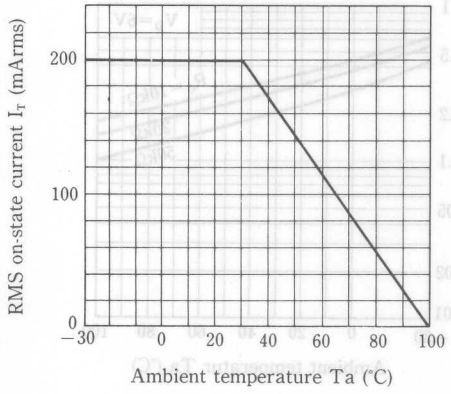


Fig. 2 Forward Current vs. Ambient Temperature

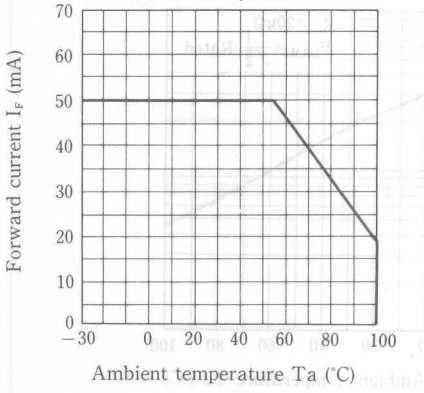


Fig. 3 Forward Current vs. Forward Voltage

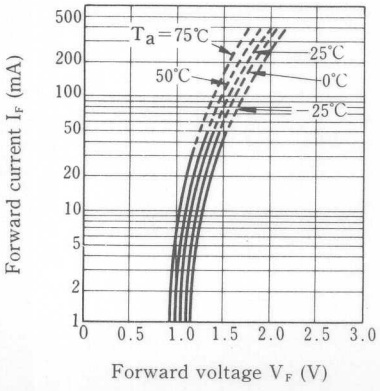
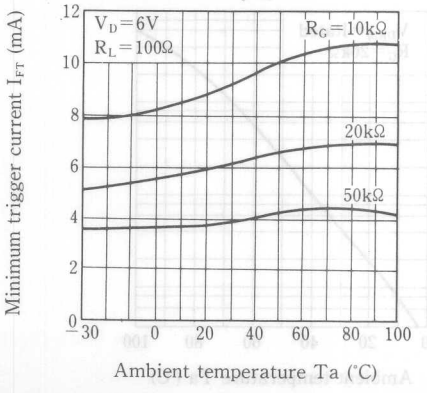


Fig. 4 Minimum Trigger Current vs. Ambient Temperature



6

Fig. 5 Minimum Trigger Current vs. Gate Resistance

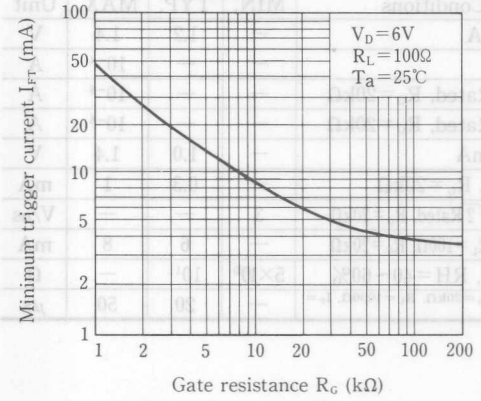


Fig. 6 Break Over Voltage vs. Ambient Temperature

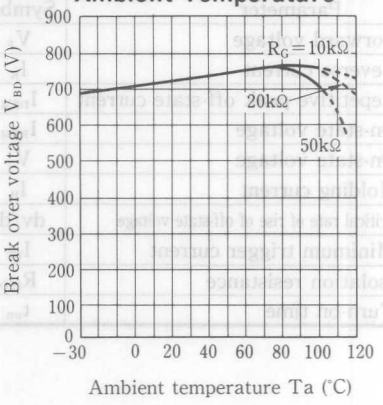


Fig. 7 Critical Rate of Rise of Off-state Voltage vs. Ambient Temperature

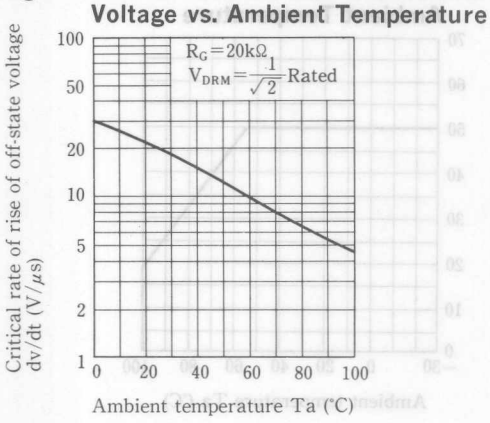


Fig. 8 Holding Current vs. Ambient Temperature

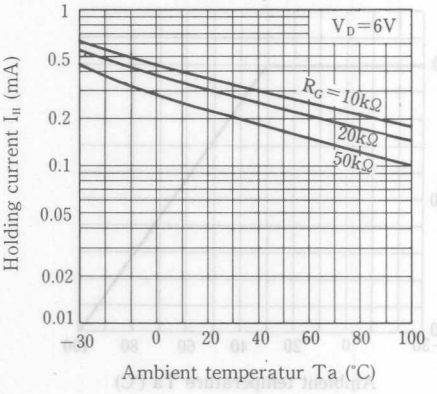
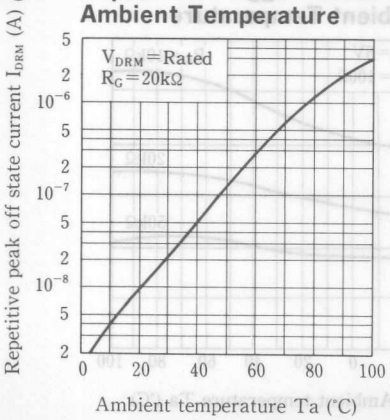
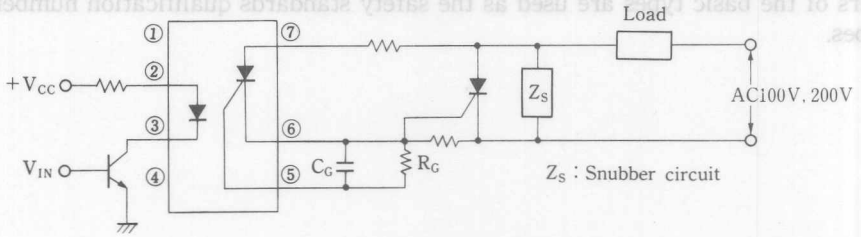


Fig. 9 Repetitive Peak Off-state Current vs. Ambient Temperature

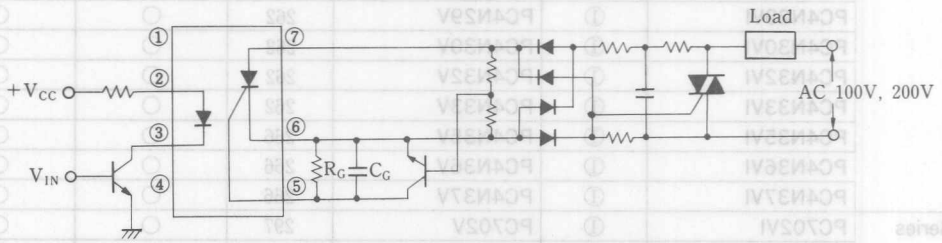


■ Basic Operation Circuit

High Power Thyristor Drive Circuit



High Power Triac Drive Circuit (Zero-cross Operation)



6

I Type/VI(W)Type

The I and VI (W) types have the same electrical specifications as those of the basic types. The product numbers of the basic types are used as the safety standards qualification numbers for I and VI (W) types.



■ Features

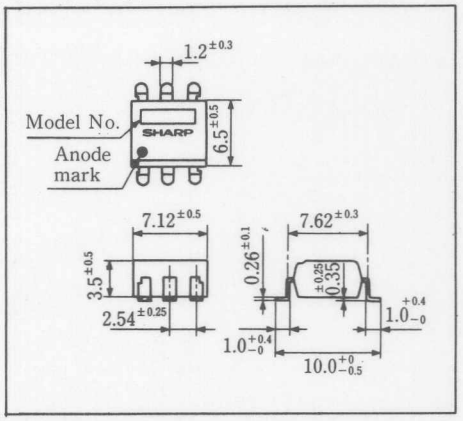
I type·····Lead forming type, for surface mounting
VI (W) type·····Lead forming type of multi-cutting (V type), for surface mounting

I type/VI type		Outline Drawing	Basic type	page	Safety standard approved UL	TÜV
PC4N Series	PC4N25VI	①	PC4N25V	258	○	○
	PC4N26VI	①	PC4N26V	258	○	○
	PC4N27VI	①	PC4N27V	258	○	○
	PC4N28VI	①	PC4N28V	258	○	—
	PC4N29VI	①	PC4N29V	262	○	○
	PC4N30VI	①	PC4N30V	262	○	○
	PC4N32VI	①	PC4N32V	262	○	○
	PC4N33VI	①	PC4N33V	262	○	○
	PC4N35VI	①	PC4N35V	266	○	○
	PC4N36VI	①	PC4N36V	266	○	○
	PC4N37VI	①	PC4N37V	266	○	○
PC700 Series	PC702VI	①	PC702V	297	○	○
	PC703VI	①	PC703V	301	○	○
	PC713VI	①	PC713V	305	○	○
	PC714VI	①	PC714V	305	○	○
	PC715VI	①	PC715V	309	○	○
	PC716VI	①	PC716V	313	○	○
	PC723VI	①	PC723V	317	○	○
	PC725W	①	PC725V	325	△	△
	PC733I	②	PC733	329	○	—
PC800 Series	PC810I	③	PC810	337	○	—
	PC814I	③	PC814	350	○	—
	PC815I	③	PC815	355	○	○
	PC817I	③	PC817	363	○	○
	PC818I	③	PC818	367	○	○
	PC851I	③	PC851	371	○	—
PC900 Series	PC900VI	①	PC900V	388	○	○
Photothyristor coupler/ Phototriac coupler	S11MD5VI	①	S11MD5V	445	○	—
	S12MD1VI	①	S12MD1V	454	△	—
	S21MD4W	①	S21MD4V	470	○	○
	S22MD1VI	①	S22MD1V	474	△	△
	S21MD3W	①	S21MD3V	462	○	○

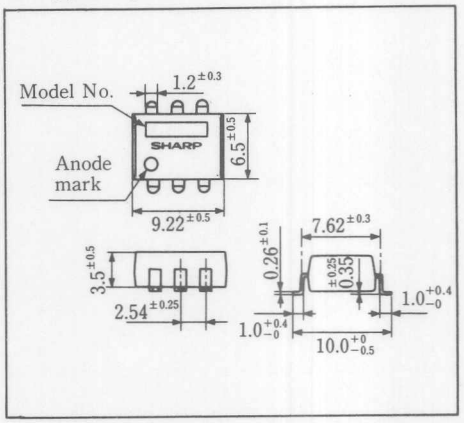
○: Approved △: Under preparation

■ Outline Dimensions (Unit : mm)

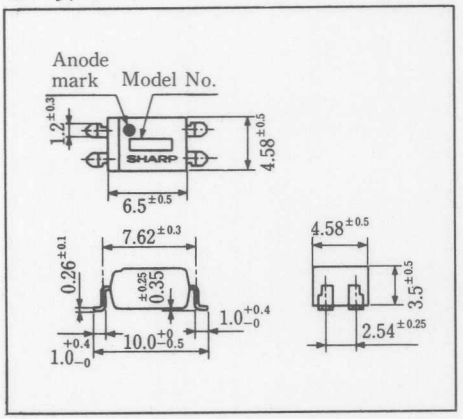
①VI (W) type



②I type, 6-pin



③I type, 4-pin



6

■ Outline Dimensions (Unit : mm)

Photointerrupters

7

GP1A05/GP1A22LC/ GP1A23LC/GP1A25LC

OPIC Photointerrupters with Connector

■ Features

1. Uses 3-pin connector terminal
2. High sensing accuracy (Slit width : 0.5mm)
3. Wide gap between light emitter and detector (5mm)

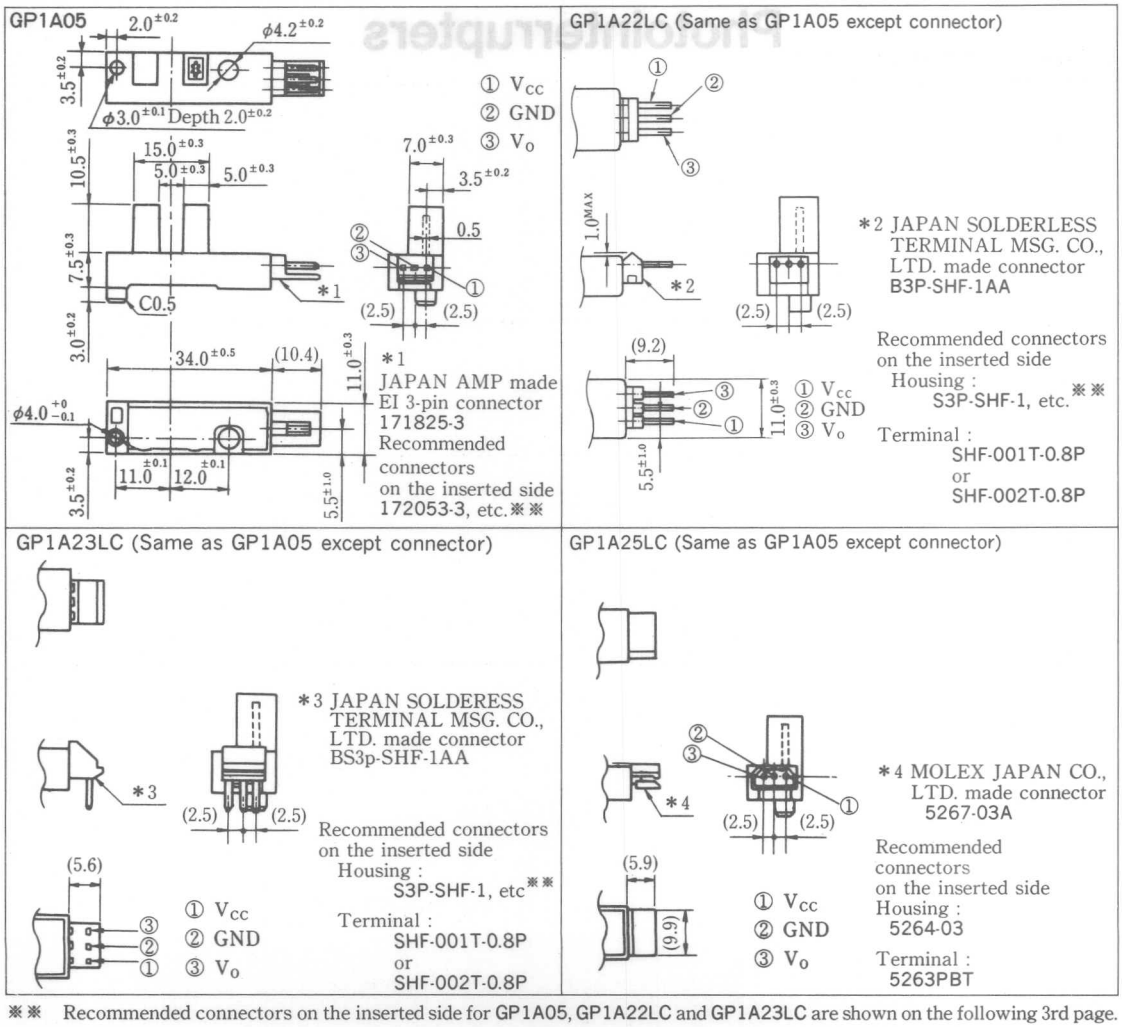
■ Applications

1. Copiers, printers, facsimiles

※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

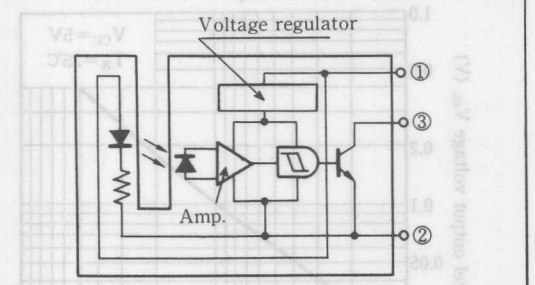
■ Outline Dimensions

(Unit : mm)



※※ Recommended connectors on the inserted side for GP1A05, GP1A22LC and GP1A23LC are shown on the following 3rd page.

Internal connection diagram (Common to 4 models)



① V_{CC}
② GND
③ V_O

■ Abnolute Maximum Ratings

(Ta=25°C)

Parameter		Symbol	Rating	Unit
Supply voltage	GP1A05	V_{CC}	10	V
	GP1A22LC/GP1A23LC/GP1A25LC		8	
*5Output voltage		V_O	28	V
*6Low level output current		I_{OL}	50	mA
*7Operating temperature		T_{opr}	−20～+75	°C
*7Storage temperature	GP1A05/GP1A22LC/GP1A23LC	T_{stg}	−40～+85	°C
	GP1A25LC		−30～+85	

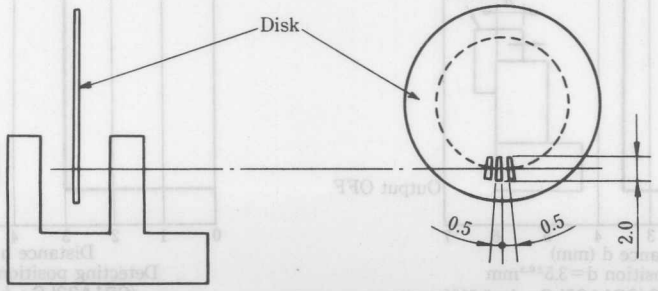
*5 Collector-emitter voltage of output transistor
*6 Collector current of output transistor
*7 The connector should be plugged in/out at normal temperature.

■ Electro-optical Characteristics

(Unless otherwise specified, V_{CC}=5V, Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage	V_{CC}		4.5	—	5.5	V
Low level supply current	I_{CCL}	Light beam uninterrupted	—	—	30	mA
Low level output voltage	V_{OL}	Light beam uninterrupted, I_{OL}=16mA	—	—	0.35	V
High level supply current	I_{CCH}	Light beam interrupted	—	—	30	mA
High level output voltage	V_{OH}	Light beam interrupted, R_L=47kΩ	V_{CC}×0.9	—	—	V
*9Response frequency	f	*8R_L=47kΩ	—	—	3,000	Hz

*8 No DC output is allowed.
*9 Response frequency is measured with the disk shown below being rotated. (Unit : mm)



7

Fig. 1 Low Level Output Current vs. Ambient Temperature

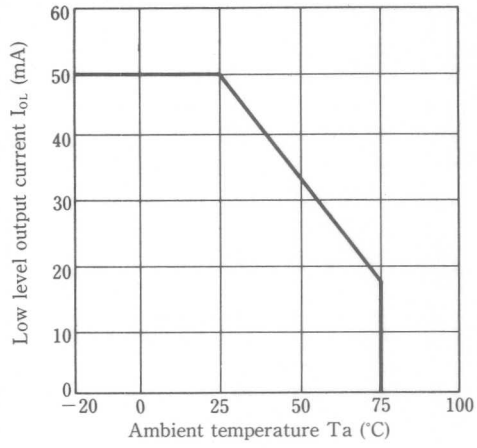


Fig. 2 Low Level Output Voltage vs. Low Level Output Current

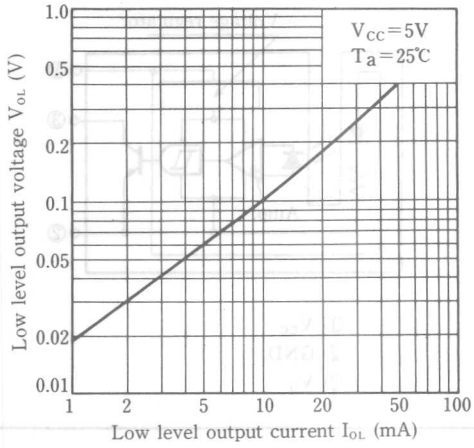


Fig. 3 Low Level Output Voltage vs. Ambient Temperature

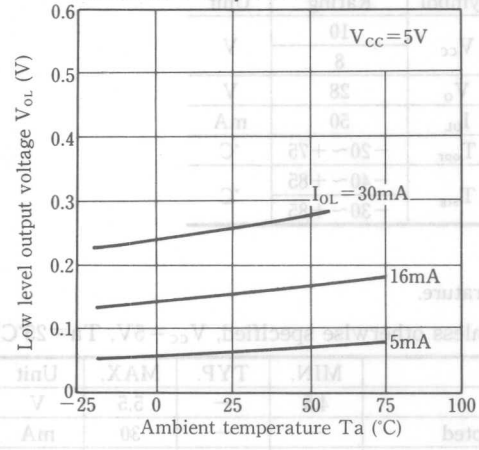


Fig. 4 Supply Current vs. Supply Voltage

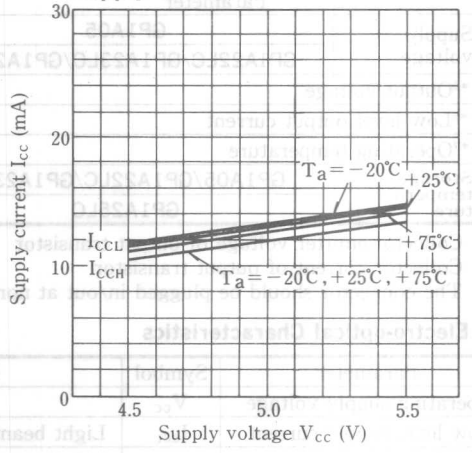
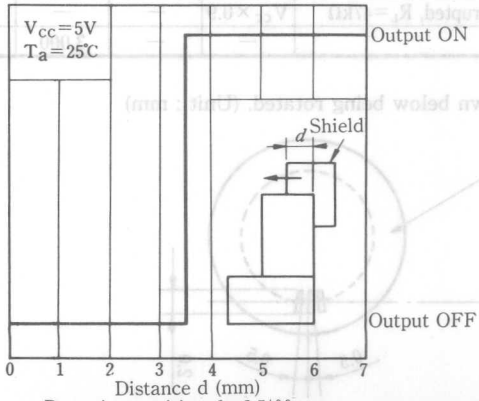
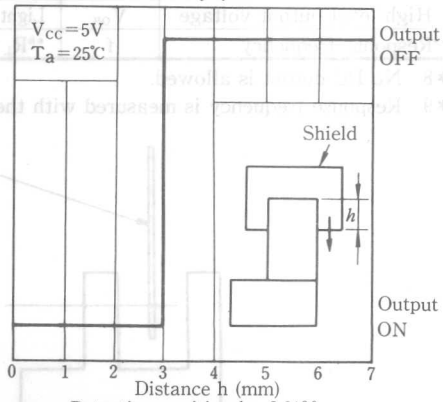


Fig. 5 Detecting Position Characteristics (1)



Detecting position d=$3.5^{\pm0.3}$mm
(GP1A22LC/GP1A23LC/GP1A25LC : d=$3.5^{\pm0.5}$mm)

Fig. 6 Detecting Position Characteristics (2)



Detecting position h=$3.0^{+2.0}_{-1.5}$mm
(GP1A22LC : h=$3.0^{+2.0}_{-1.0}$mm)

■ Recommended Connectors on the Inserted Side

Recommended connectors on the inserted side for GP1A05, GP1A22LC and GP1A23LC are shown below.

《GP1A05》

●JAPAN AMP made EI series connectors (standard type)

Housing color	Natural color	Black	Blue	Green	Red
Housing Model No.	171822-3	2-171822-3	4-171822-3	6-171822-3	8-171822-3

	AWG size	Product shape	Material	Model No.
Special terminal Model. No.	AWG 26～20	Bulk	Brass	170204-1
			Copper phosphide	170204-2
		Chain	Brass	170262-1
			Copper phosphide	170262-2
	AWG 30～26	Bulk	Brass	170205-1
			Copper phosphide	170205-2
		Chain	Brass	170263-1
			Copper phosphide	170263-2

●JAPAN AMP made EI series connectors (low profile type)

Housing color	Natural color	Black	Blue	Green	Red
Housing Model No.	172142-3	2-172142-3	4-172142-3	6-172142-3	8-172142-3

	AWG size	Product shape	Model No.
Special terminal Model No. (Material : Copper phosphide)	AWG 26～22	Bulk	170369-1
		Chain	170354-1
	AWG 30～26	Bulk	170370-1
		Chain	170355-1

●JAPAN AMP made EI series connectors (amp mass termination)

Housing-terminal united type connector	AWG28 (Green)	AWG26 (Natural color)	AWG24 (Black)	AWG22 (Red)
	172054-3	172053-3	172052-3	172051-3

* Terminal Material : Copper phosphide

《GP1A22LC/GP1A23LC》

●JAPAN SOLDERLESS TERMINAL MSG. CO., LTD. made (Natural color・bulk)

Housing Model No.	H3P-SHF-AA			S3P-SHF-1		
	AWG size	Material	Model No.	AWG size	Material	Model No.
Special terminal Model No.	AWG 26～22	Brass	SHF-001T-0.8SS	AWG 27～22	Brass	SHF-001T-0.8P
		Copper phosphide	SHF-001T-0.8BS		Copper phosphide	———
	AWG 30～28	Brass	SHF-002T-0.8SS	AWG 30～28	Brass	SHF-002T-0.8P
		Copper phosphide	SHF-002T-0.8BS		Copper phosphide	———

■ Precautions for Use

- It is recommended that a by-pass capacitor of more than 0.01μF be added between V_{CC} and GND near the device in order to stabilize power supply line.
- In this product, the PWB is fixed with a rear cover, and cleaning solvent may remain inside the case; therefore, dip cleaning or ultrasonic cleaning is prohibited.
- Remove dust or stains, using an air blower or a soft cloth moistened in cleaning solvent. However, do not perform the above cleaning using a soft cloth with cleaning solvent in the marking portion.

  In this case, use only the following type of cleaning solvent used for wiping off:

  Ethyl alcohol, Methyl alcohol, Isopropyl alcohol,

  Freon TE, Freon TF, Diflon solvent S3-E

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GP1A05HR/GP1A22HR OPIC Photointerrupter with Connector

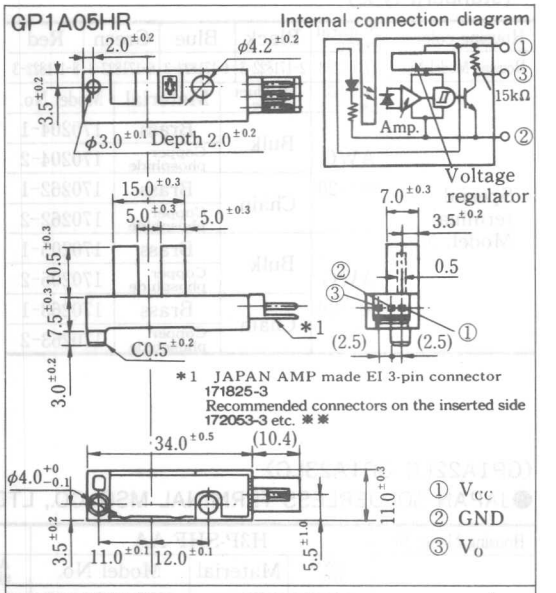
■ Features

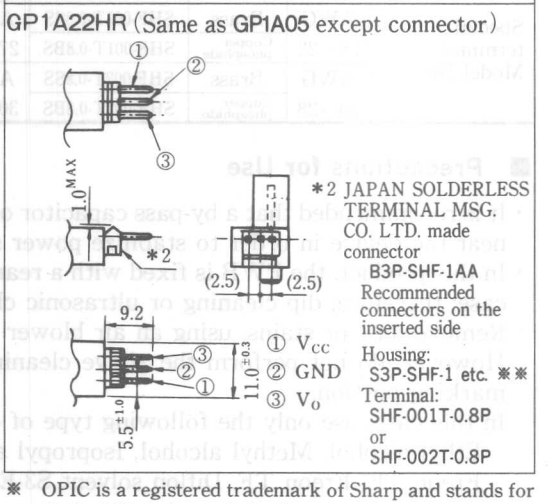
1. 3-pin connector terminal
2. High sensing accuracy (Slit width: 0.5mm)
3. Wide gap between light emitter and detector (5mm)

■ Applications

1. Copiers
2. Printers
3. Facsimiles

■ Outline Dimensions (Unit : mm)





※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

※※ Recommended connectors on the inserted side are shown on the page after next.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	8	V
*3Low level output current	I_{OL}	50	mA
*4Operating temperature	T_{opr}	−20～+75	°C
*4Storage temperature	T_{stg}	−40～+85	°C

*3 Collector current of output transistor
*4 The connector should be plugged in/out at normal temperature.

■ Electro-optical Characteristics (Unless otherwise specified V_{CC}=5V, Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage	V_{CC}		4.5	—	5.5	V
Low level supply current	I_{CCL}	Light beam interrupted	—	—	30	mA
Low level output voltage	V_{OL}	Light beam interrupted, I_{OL}=16mA	—	—	0.4	V
High level supply current	I_{CCH}	Light beam uninterrupted	—	—	30	mA
High level output voltage	V_{OH}	Light beam uninterrupted	V_{CC}×0.9	—	—	V
*6Response Frequency	f	*5	—	—	3,000	Hz

*5 Output should not keep DC level.
*6 Response frequency is measured with the disk shown below being rotated. (Unit:mm)

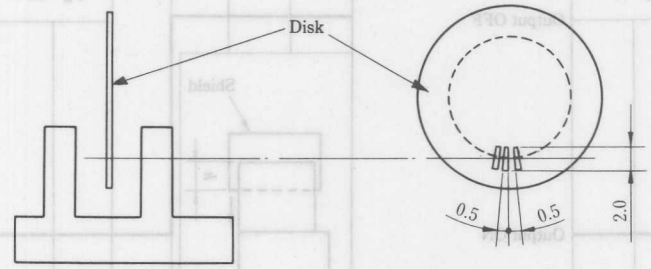


Fig. 1 Low Level Output Current vs. Ambient Temperature

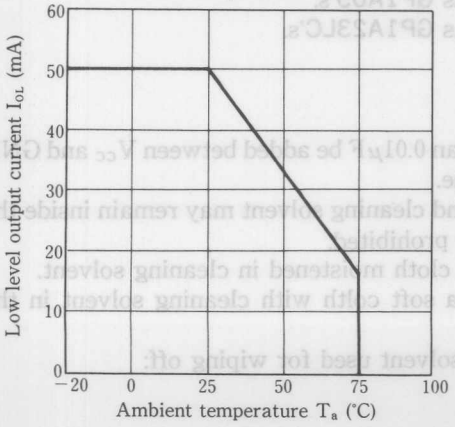
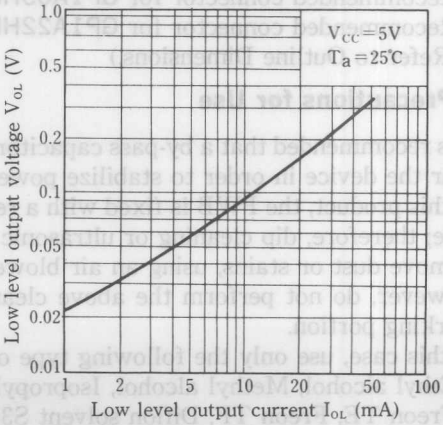


Fig. 2 Low Level Output Voltage vs. Low Level Output Current



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Fig. 3 Low Level Output Voltage vs. Ambient Temperature

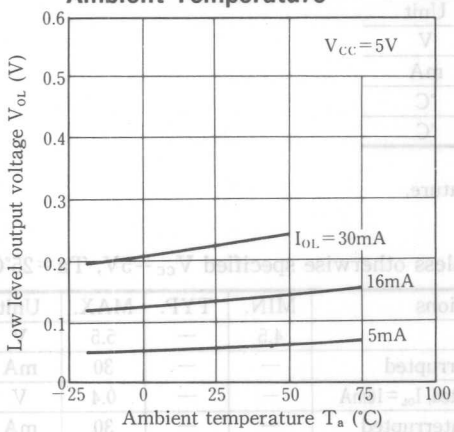


Fig. 4 Supply Current vs. Supply Voltage

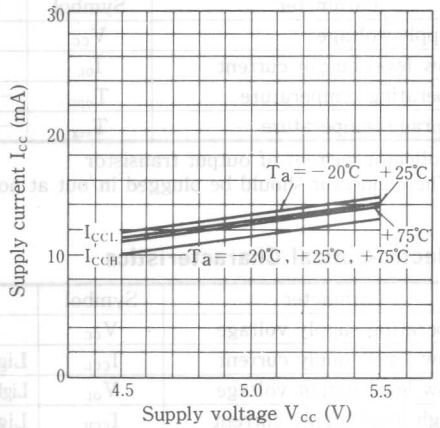
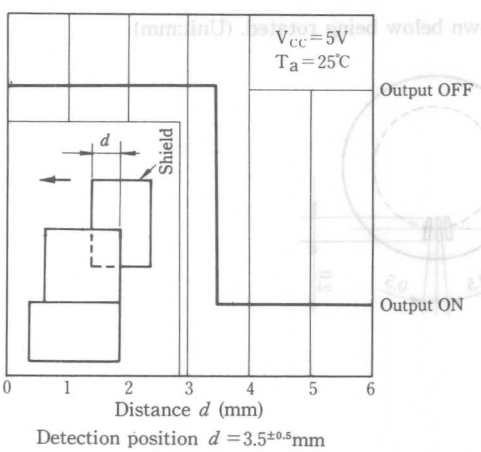
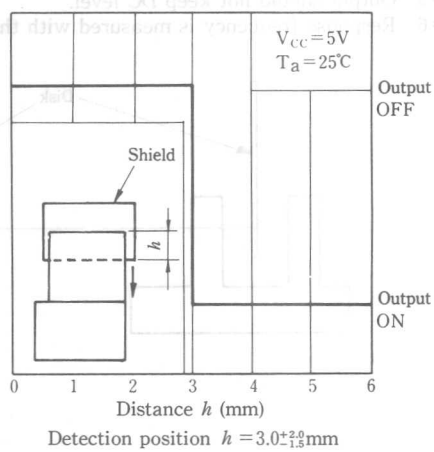


Fig. 5 Detecting Position Characteristics (1)



Detection position $d = 3.5^{\pm 0.5}$mm

Fig. 6 Detecting Position Characteristics (2)



Detection position $h = 3.0^{\pm 2.0}_{\pm 1.5}$mm

■ Recommended Connectors on the Inserted Side

Recommended connector for GP1A05HR is same as GP1A05's.
Recommended connector for GP1A22HR is same as GP1A23LC's.
(Refer to Outline Dimensions.)

■ Precautions for Use

- It is recommended that a by-pass capacitor of more than 0.01μF be added between V_{CC} and GND near the device in order to stabilize power supply line.
- In this product, the PWB is fixed with a rear cover, and cleaning solvent may remain inside the case; therefore, dip cleaning or ultrasonic cleaning is prohibited.
- Remove dust or stains, using an air blower or a soft cloth moistened in cleaning solvent. However, do not perform the above cleaning using a soft colth with cleaning solvent in the marking portion.

  In this case, use only the following type of cleaning solvent used for wiping off:
  Ethyl alcohol, Methyl alcohol, Isopropyl alcohol,
  Freon TE, Freon TF, Diflon solvent S3-E

GP1A06 2-phase Digital Output Type OPIC Photointerrupter

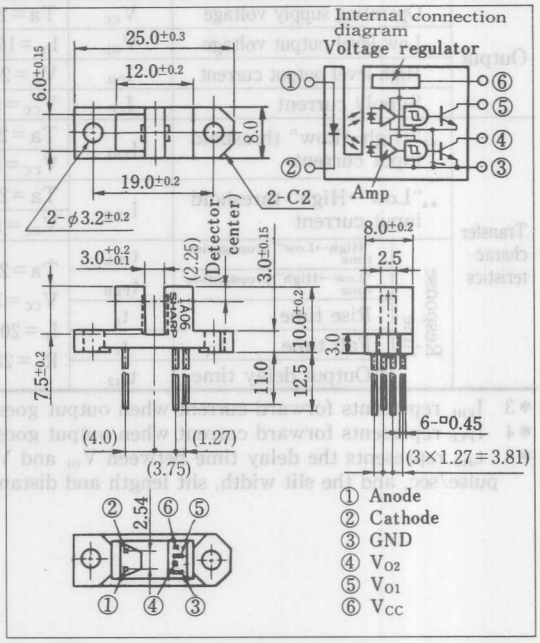
■ Features

1. Built-in Schmidt trigger circuit
2. 2-phase digital output with phase difference
3. LSTTL and TTL compatible output
4. Operating supply voltage V_{CC}: 4.5~16V

■ Applications

1. Tape counters in VCRs and cassette tape recorders
2. Copiers, facsimiles
3. Industrial robots, NC machines
4. Electronic scales

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

7

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	16	V
	Low level output current	I_{OL}	20	mA
	High level output voltage	V_{OH}	20	V
	Power dissipation	P_O	250	mW
Operating temperature		T_{opr}	−20~+85	°C
Storage temperature		T_{stg}	−40~+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta = 0 ~ +70°C unless specified)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	Ta = 25°C, I_F = 20mA	—	1.2	1.4	V
	Reverse current		I_R	Ta = 25°C, V_R = 3V	—	—	10	μA
Output	Operating supply voltage		V_{CC}	Ta = 25°C	4.5	—	16	V
	Low level output voltage		V_{OL}	I_{OL} = 16mA, V_{CC} = 5V, I_F = 20mA	—	0.2	0.4	V
	High level output current		I_{OH}	V_O = 20V, V_{CC} = 16V, I_F = 0	—	—	100	μA
	Supply current		I_{CC}	V_{CC} = 5V	—	7.0	15	mA
Transfer characteristics	*3"High→Low" threshold input current		I_{FHL}	Ta = 25°C, V_{CC} = 5V, R_L = 280Ω	—	3.0	15	mA
				V_{CC} = 5V, R_L = 280Ω	—	—	20	
	*4"Low→High" threshold input current		I_{FLH}	Ta = 25°C, V_{CC} = 5V, R_L = 280Ω	0.4	1.8	—	mA
				V_{CC} = 5V, R_L = 280Ω	0.3	—	—	
	Response time	"High→Low" propagation time	t_{PHL}	Ta = 25°C V_{CC} = 5V I_F = 20mA R_L = 280Ω	—	1.0	5.0	μs
		"Low→High" propagation time	t_{PLH}		—	2.0	10	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.1	0.5	
		*5Output delay time	t_{d12}		1.0	—	—	

*3 I_{FHL} represents forward current when output goes from high to low.
*4 I_{FLH} represents forward current when output goes from low to high.
*5 t_{d12} represents the delay time between V_{O1} and V_{O2} output. The disk shall be rotated at the speed of 1,000 pulse/sec, and the slit width, slit length and distance between slits are all 2.0 mm.

Fig. 1 Forward Current vs. Ambient Temperature

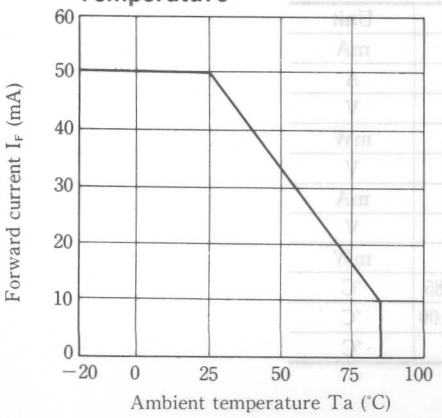


Fig. 2 Output Power Dissipation vs. Ambient Temperature

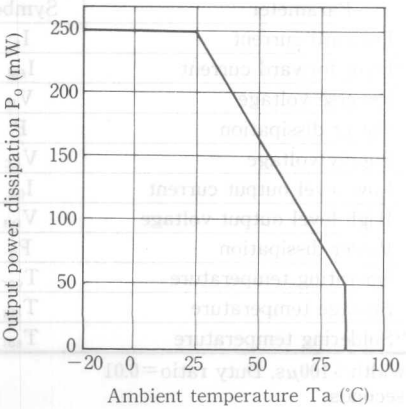


Fig. 3 Forward Current vs. Forward Voltage

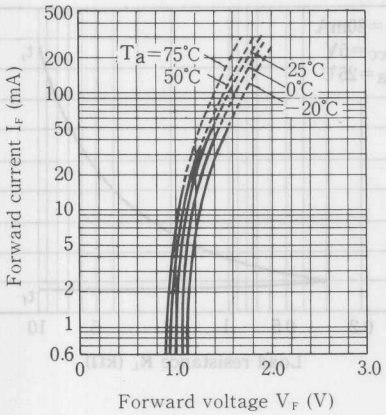


Fig. 4 Relative Threshold Input Current vs. Supply Voltage

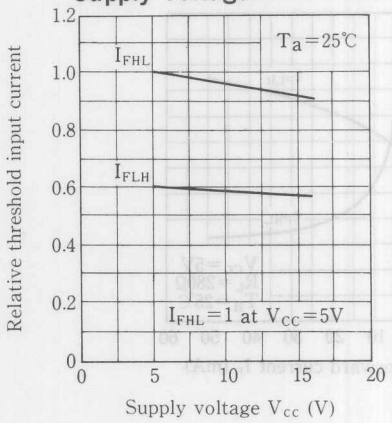


Fig. 5 Relative Threshold Input Current vs. Ambient Temperature

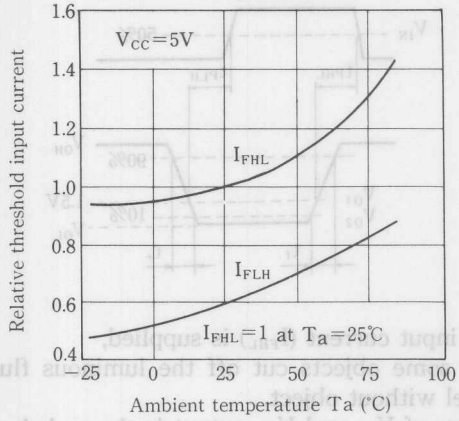


Fig. 6 Low Level Output Voltage vs. Low Level Output Current

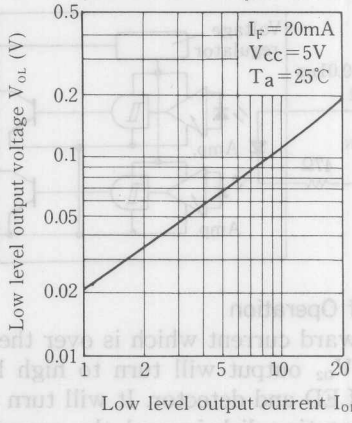


Fig. 7 Low Level Output Voltage vs. Ambient Temperature

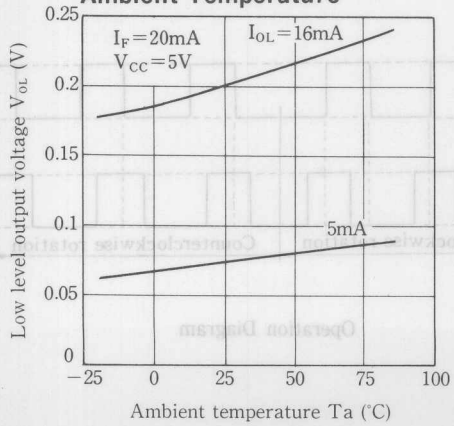
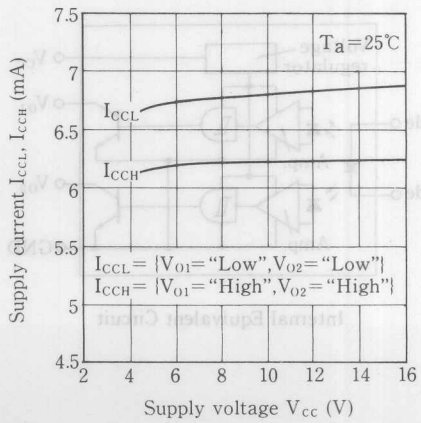


Fig. 8 Supply Current vs. Supply Voltage



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Fig. 9 Propagation Time vs. Forward Current

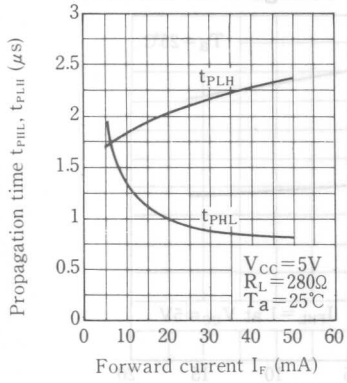
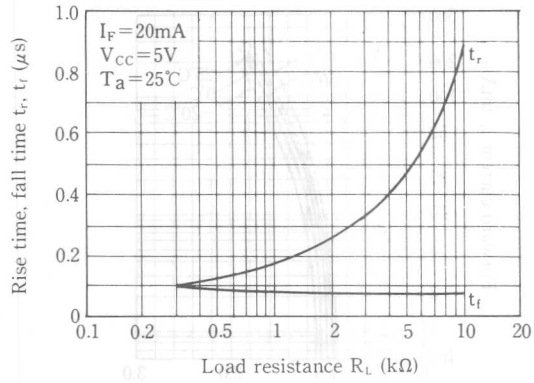
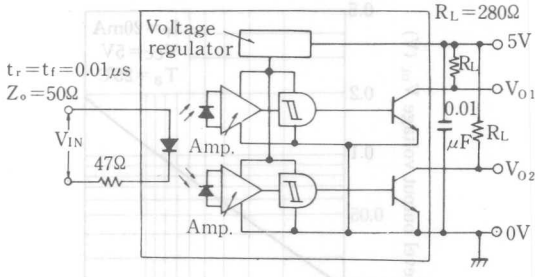
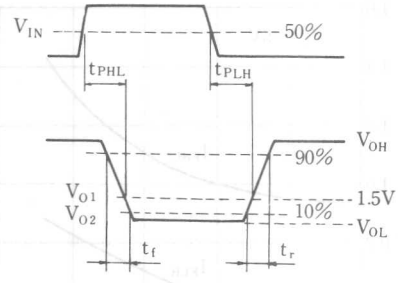


Fig. 10 Rise, Time, Fall Time vs. Load Resistance



Test Circuit for Response Time



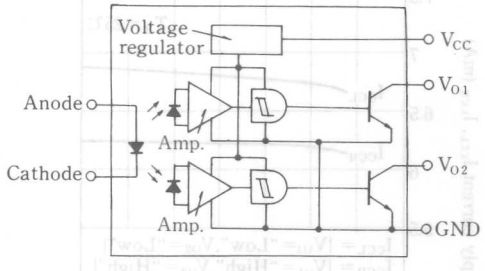


Explanation of Operation

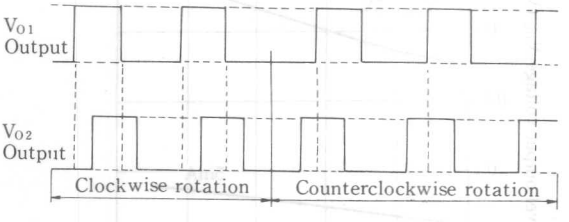
When the forward current which is over the threshold input current (I_{FHL}) is supplied;

(1) V_{O1} and V_{O2} output will turn to high level when some objects cut off the luminous flux between LED and detector. It will turn to low level without object.

(2) When a rotating disk is used, the operation diagram of V_{O1} and V_{O2} output is shown below.

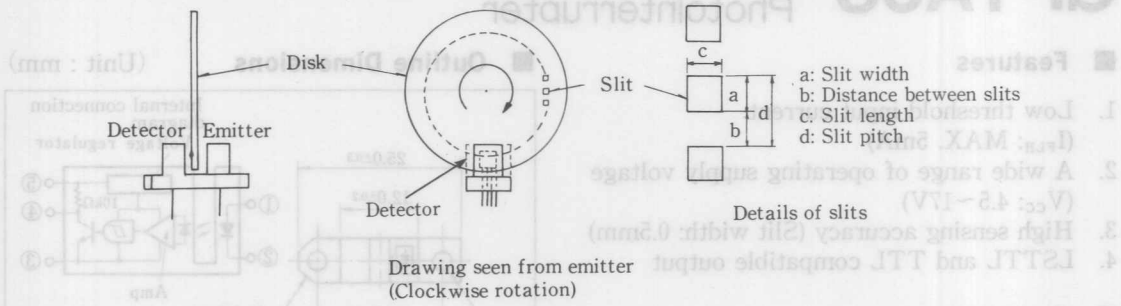


Internal Equivalent Circuit



Operation Diagram

Definition of Rotational Direction



(Precautions for Use)

- The slit shall be designed as follows: a, b, c=2mm, d=4mm
- In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

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GP1A08 High Sensitivity Type OPIC Photointerrupter

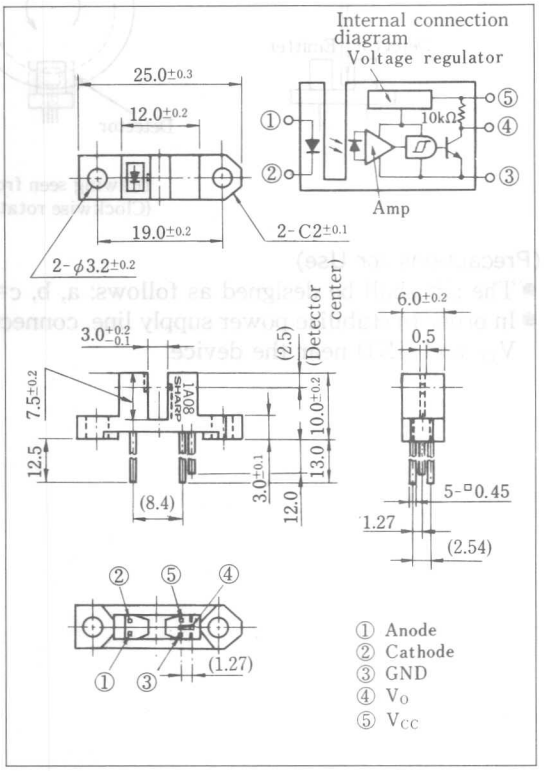
■ Features

1. Low threshold input current (I_{FLH}: MAX. 5mA)
2. A wide range of operating supply voltage (V_{CC}: 4.5～17V)
3. High sensing accuracy (Slit width: 0.5mm)
4. LSTTL and TTL compatible output

■ Applications

1. Copiers, printers, facsimiles
2. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=5mA	—	1.1	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V	—	0.15	0.4	V
	High level output current		V_{OH}	V_{CC}=5V, I_F=5mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	2.5	5	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=5mA	—	1	3	mA
Transfer characteristics	*3"Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	1	5	mA
	*4Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V	0.55	0.75	0.95	—
	Response time	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=5mA, R_L=280Ω	—	3	9	μs
		"High→Low" propagation time	t_{PHL}		—	5	15	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output goes from low to high
*4 I_{FHL} represents forward current when output goes from high to low

(Precautions for Use)

In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

7

Fig. 1 Forward Current vs. Ambient Temperature

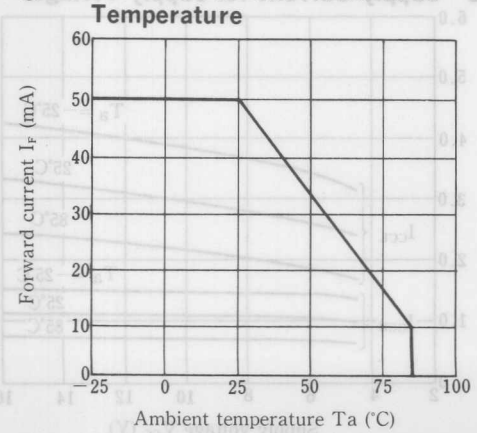


Fig. 2 Output Power Dissipation vs. Ambient Temperature

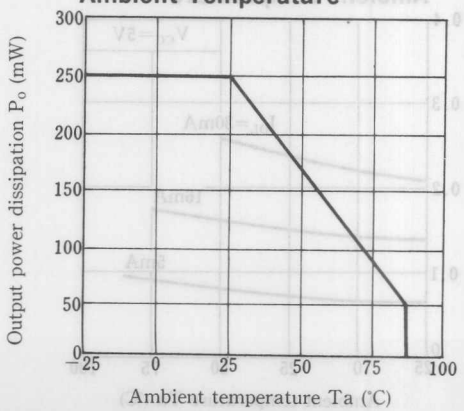


Fig. 3 Forward Current vs. Forward Voltage

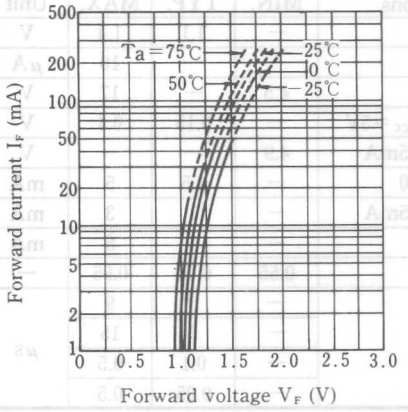


Fig. 4 Relative Threshold Input Current vs. Supply Voltage

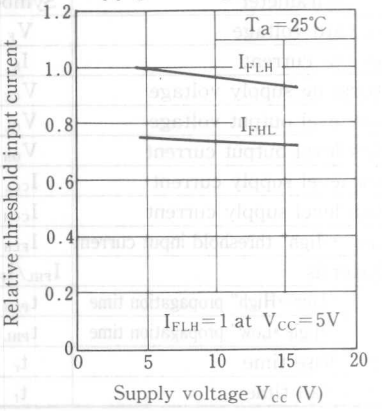


Fig. 5 Relative Threshold Input Current vs. Ambient Temperature

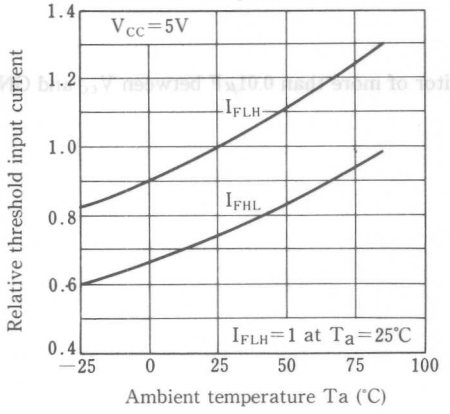


Fig. 6 Low Level Output Voltage vs. Low Level Output Current

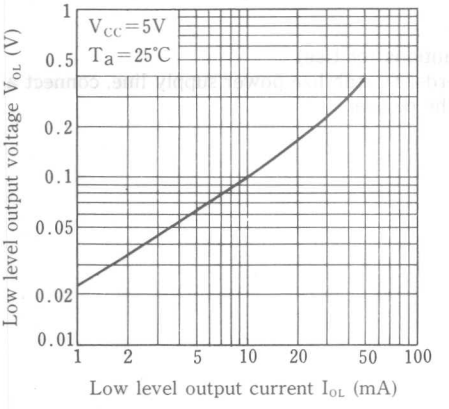


Fig. 7 Low Level Output Voltage vs. Ambient Temperature

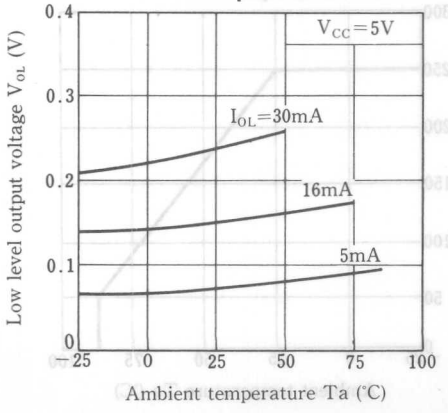


Fig. 8 Supply Current vs. Supply Voltage

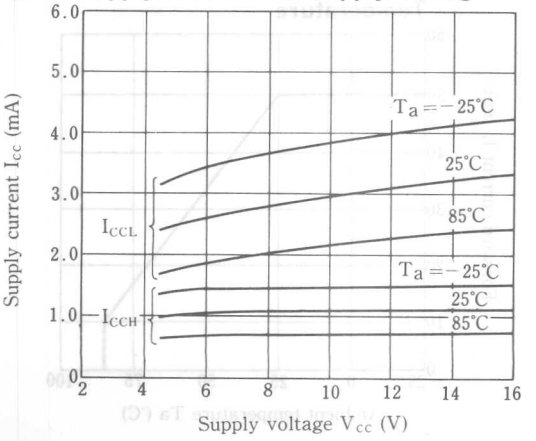


Fig. 9 Propagation Time vs. Forward Current

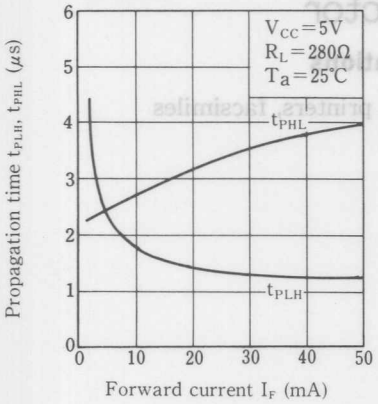
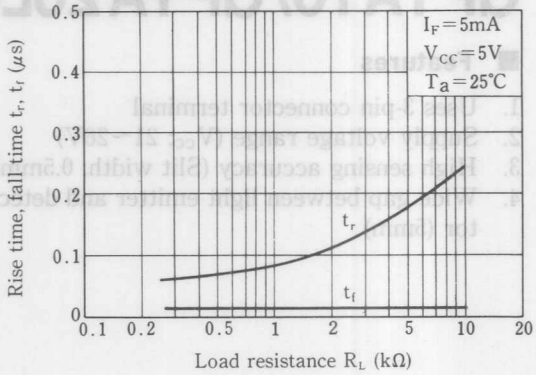
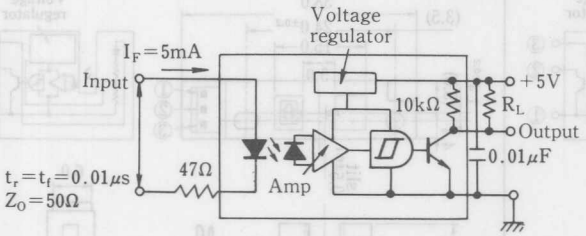
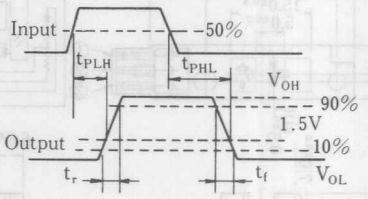


Fig. 10 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





7

GP1A10/GP1A26LC OPIC Photointerrupter with Connector

■ Features

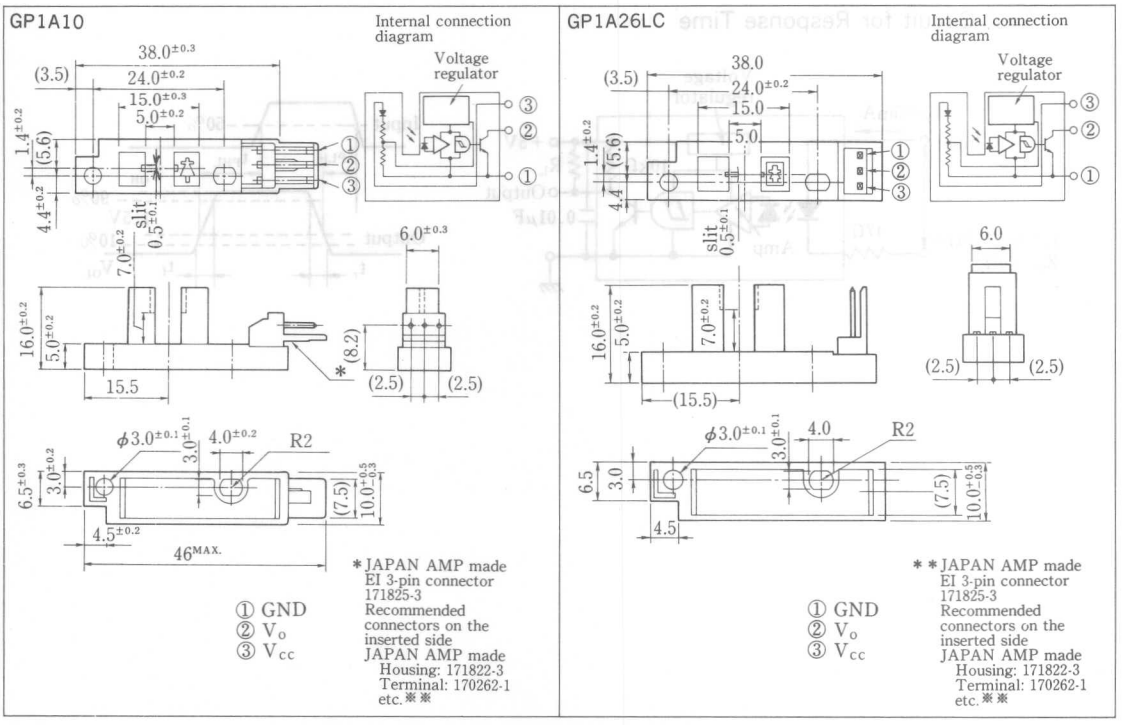
1. Uses 3-pin connector terminal
2. Supply voltage range (V_{CC}: 21~26V)
3. High sensing accuracy (Slit width: 0.5mm)
4. Wide gap between light emitter and detector (5mm)

■ Applications

1. Copiers, printers, facsimiles

■ Outline Dimensions

(Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a sdngle chip.

※※ Recommended connectors on the inserted side (See 505page).

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	−0.5～+30	V
*1Output voltage	V_O	−0.5～+40	V
*2Low level output current	I_{OL}	50	mA
*3Operating temperature	T_{opr}	0～+80 (GP1A26LC: −20～+80°C)	°C
*3Storage temperature	T_{stg}	−20～+95	°C
Operating humidity	R_H	10～95	%

*1 Output transistor between collector-emitter voltage
*2 Collector current of output transistor
*3 The connector should be plugged in/out at normal temperature.

■ Electro-optical Characteristics (V_{CC}=24V, Ta=25°C unless otherwise specified)

Parameter		Symbol	conditions	MIN.	TYP.	MAX.	Unit
Operating voltage		V_{CC}	—	21	—	26	V
Low level supply current		I_{CCL}	Light beam uninterrupted	—	—	30	mA
Low level output voltage		V_{OL}	Light beam uninterrupted, I_{OL}=16mA	—	—	0.6	V
High level supply current		I_{CCH}	Light beam interrupted	—	—	30	mA
High level output voltage		V_{OH}	Light beam interrupted, R_L=10kΩ, V_{CC}=26V	25.8	—	—	V
Response characteristics	Minimum interruption time	t_H	Ta=0～80°C R_L=4.7kΩ V_{CC}=24V±5%	166	—	—	μs
	Minimum sensing time	t_L		166	—	—	μs

7

Fig. 1 Low Level Output Current vs. Ambient Temperature

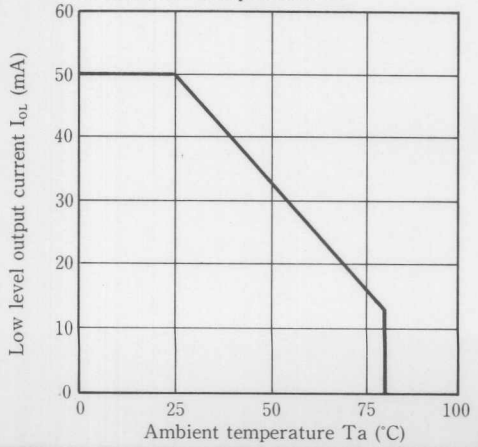


Fig. 2 Low Level Output Voltage vs. Low Level Output Current

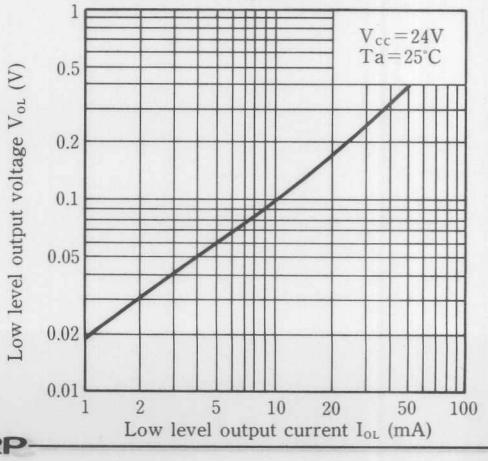


Fig. 3 Low Level Output Voltage vs. Ambient Temperature

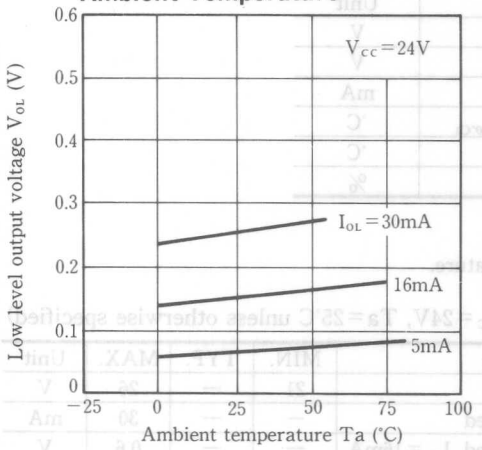


Fig. 4 Supply Current vs. Supply Voltage

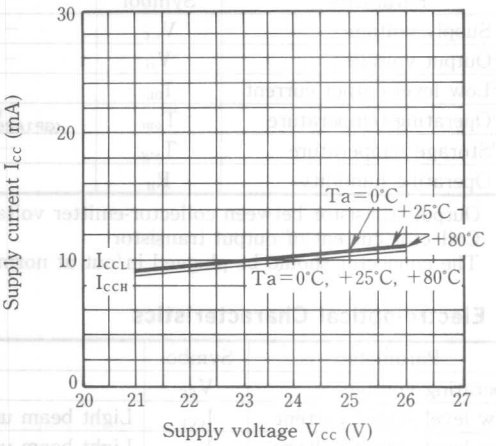
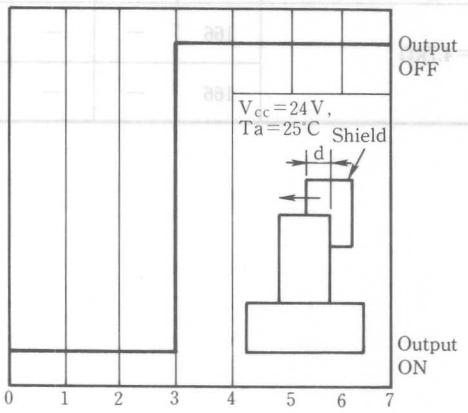
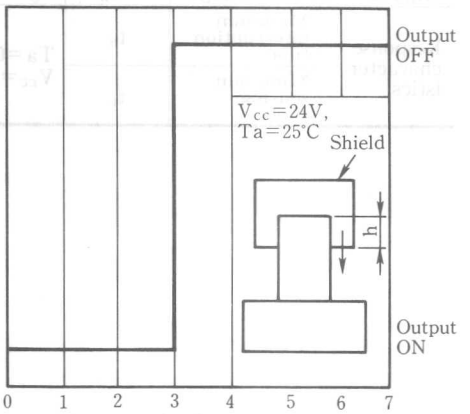


Fig. 5 Detecting Position Characteristics (1)



Detecting position d=$3.0^{\pm 0.5}$mm

Fig. 6 Detecting Position Characteristics (2)

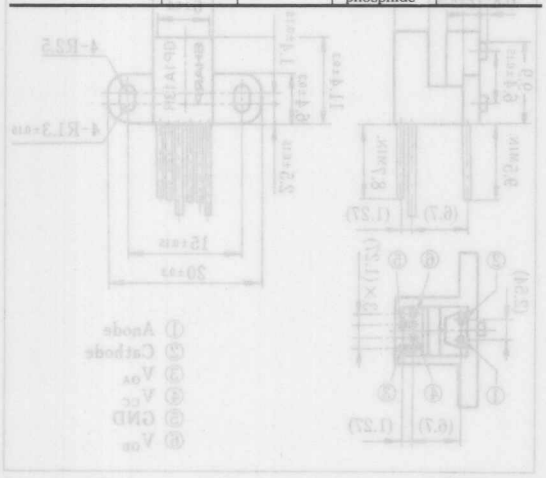


Detecting position h=$3.0^{\pm 1.0}$mm

■ Recommended Connectors on the Inserted Side

● JAPAN AMP made EI series connectors (standard type)

Housing color	Natural color	Black	Blue	Green	Red
Housing Model No.	171822-3	2-171822-3	4-171822-3	6-171822-3	8-171822-3
Special terminal Model No.	AWG size	Product shape	Material	Model No.	
	AWG 26~20	Bulk	Brass	170204-1	
			Copper phosphide	170204-2	
		Chain	Brass	170262-1	
			Copper phosphide	170262-2	
	AWG 30~26	Bulk	Brass	170205-1	
			Copper phosphide	170205-2	
		Chain	Brass	170263-1	
			Copper phosphide	170263-2	



● JAPAN AMP made EI series connectors (low profile type)

Housing color	Natural color	Black	Blue	Green	Red
Housing Model No.	172142-3	2-172142-3	4-172142-3	6-172142-3	8-172142-3
Special terminal Model No. (Material: Copper phosphide)	AWG size	Product shape		Model No.	
	AWG 26~22	Bulk		170369-1	
		Chain		170354-1	
	AWG 30~26	Bulk		170370-1	
		Chain		170355-1	

● JAPAN AMP made EI series connectors (amp. mastermination)

Housing-terminal united type connector	AWG28 (Green)	AWG26 (Natural color)	AWG24 (Black)	AWG22 (Red)
	172054-3	172053-3	172052-3	172051-3

※ Terminal Material: Copper phosphide

7

GP1A13R OPIC Photointerrupter with Encoder Function

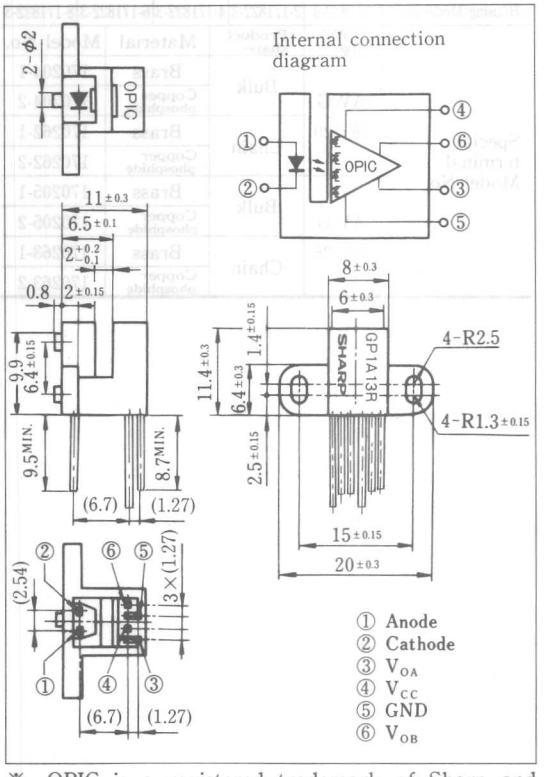
■ Features

1. A, B 2-phase digital output
2. Resolution : Slit pitch 1.6mm
3. TTL compatible output
4. Compact and light

■ Applications

1. Electronic printers
2. Robots
3. Numerical control machines

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	7	V
	Low level output current	I_{OL}	20	mA
	Power dissipation	P_O	250	mW
Operating temperature		T_{opr}	0～+70	°C
Storage temperature		T_{stg}	−40～+80	°C
*2 Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=0~+70°C unless specified)

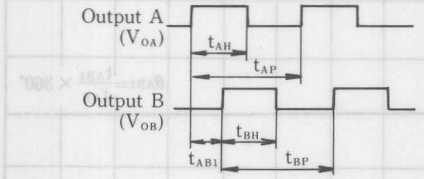
Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	Ta=25°C, I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	Ta=25°C, V_R=3V	—	—	10	μA
Output	Operating supply voltage	V_{CC}		4.5	5.0	5.5	V
	High level output voltage	V_{OL}	V_{CC}=5V, I_F=20mA, I_{OL}=8mA*4	—	0.1	0.4	V
	Low level output voltage	V_{OH}	V_{CC}=5V, I_F=20mA*4	2.4	4.9	—	V
	Supply current	I_{CC}	I_F=20mA, V_{CC}=5V*3,*4	—	5	20	mA
Transfer characteristics	Duty ratio	*5D_A	V_{CC}=5V, I_F=20mA	0.25	0.50	0.75	—
		*5D_B	f=2.5kHz*4	0.25	0.50	0.75	—
	Response frequency	$f_{max.}$	V_{CC}=5V, I_F=20mA*4	—	—	10	kHz

*3 In the condition that output A and B are low level.

*4 Measured under the condition shown in Measurement Condition.

*5 $D_A : \frac{t_{AH}}{t_{AP}}$, $D_B : \frac{t_{BH}}{t_{BP}}$

■ Output Waveforms



Rotational direction : Counterclockwise when seen from OPIC light detector

Fig. 1 Forward Current vs. Ambient Temperature

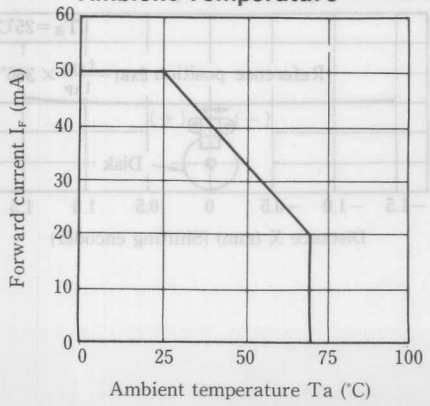
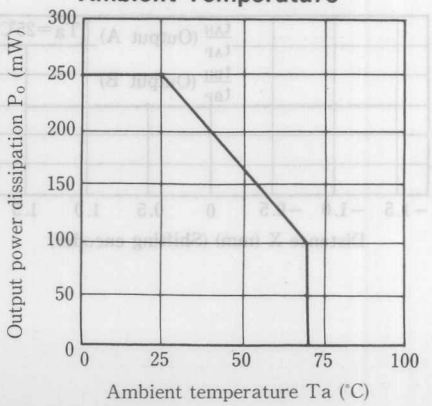


Fig. 2 Output Power Dissipation vs. Ambient Temperature



7

Fig. 3 Duty Ratio vs. Frequency

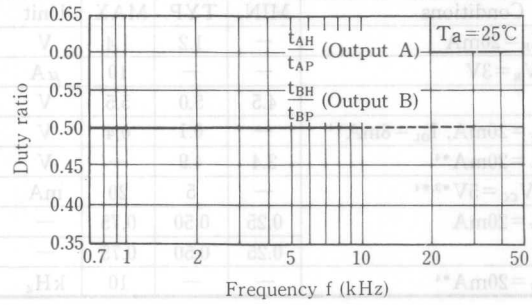


Fig. 4 Phase Difference vs. Frequency

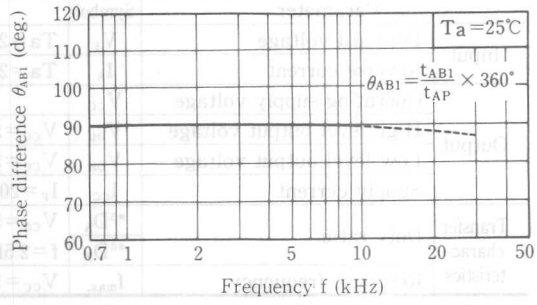


Fig. 5 Duty Ratio vs. Ambient Temperature

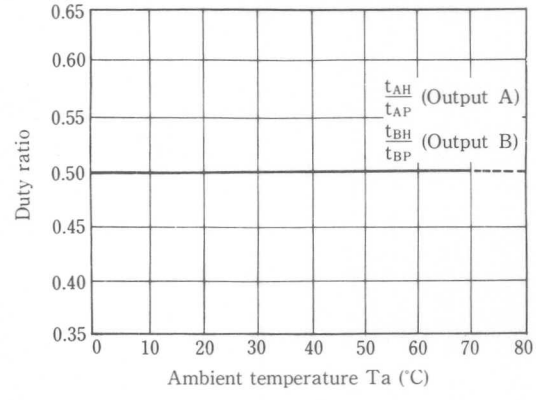


Fig. 6 Phase Difference vs. Ambient Temperature

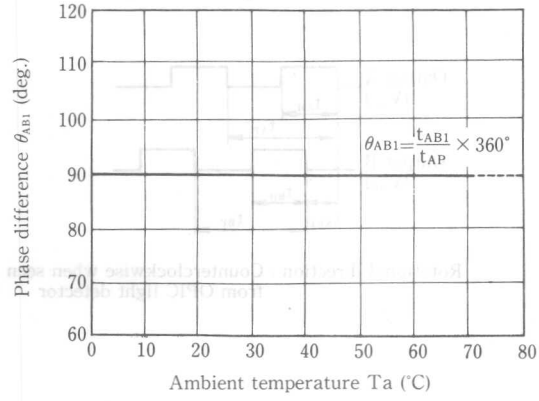


Fig. 7 Duty Ratio vs. Distance (X direction)

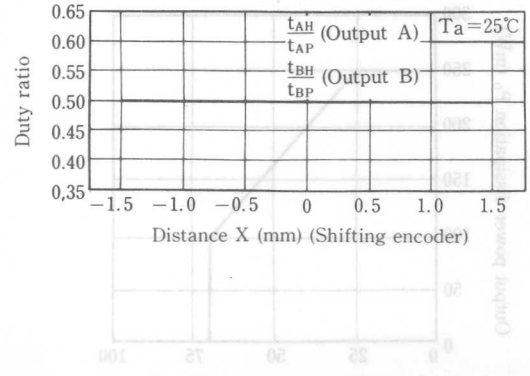


Fig. 8 Phase Difference vs. Distance (X direction)

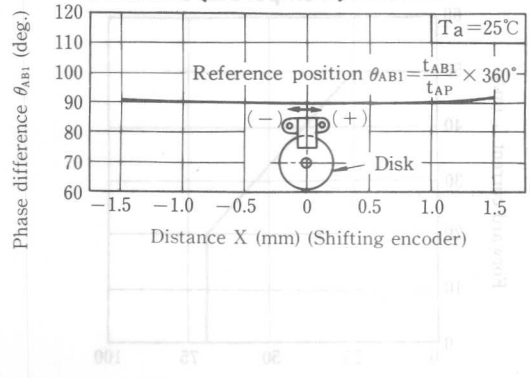


Fig. 9 Duty Ratio vs. Distance (Y direction)

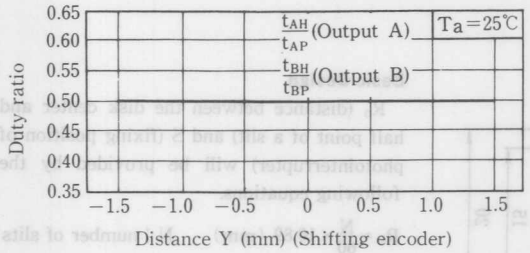


Fig.10 Phase Difference vs. Distance (Y direction)

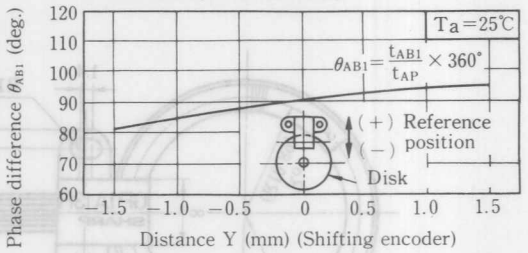


Fig. 11 Duty Ratio vs. Distance (Z direction)

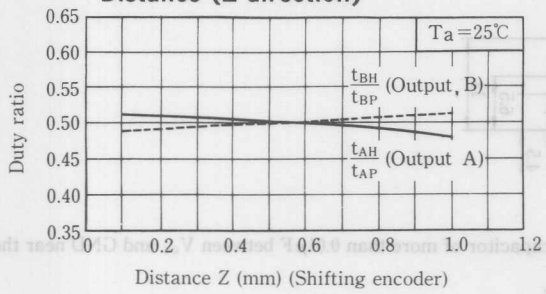
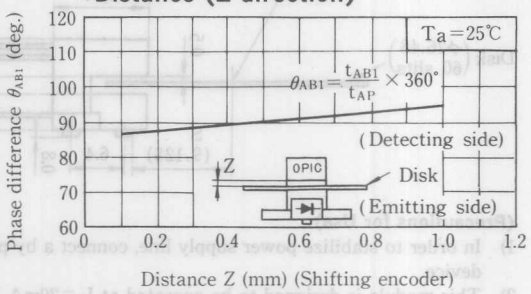
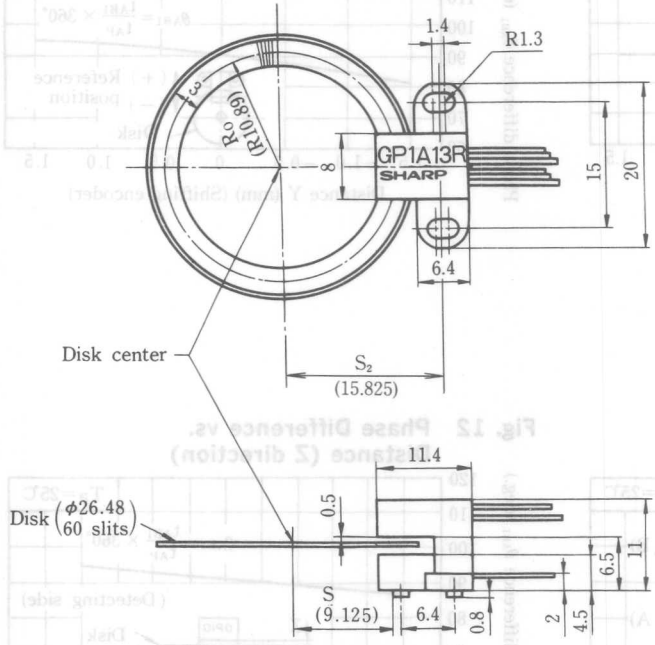


Fig. 12 Phase Difference vs. Distance (Z direction)



7

〈Measuring Condition〉



Basic Design

R_O (distance between the disk center and half point of a slit) and S (fixing position of photointerrupter) will be provided by the following equations.

$R_O = \frac{N}{60} \times 10.89$ (mm) N : number of slits

$S_1 = R_O - 1.765$ (mm) $S_2 = S_1 + 6.7$ (mm)

Note) When the number of slits is changed, values in parenthesis are also changed according to the number.

(Precautions for Use)

1) In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.
2) This module is designed to be operated at I_F = 20mA TYP.

GP1A14 High Sensitivity Type OPIC Photointerrupter

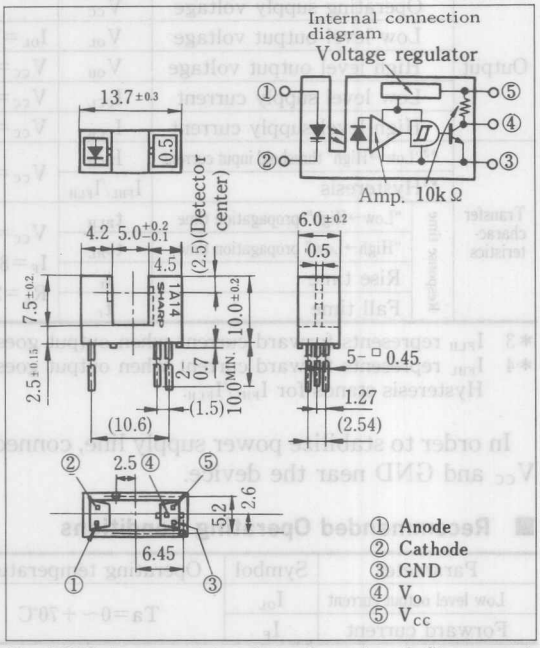
■ Features

1. Built-in Schmidt trigger circuit
2. Low threshold input current (I_{FLH} : MAX. 8mA)
3. Low level supply current (I_{CCL} : MAX. 5mA)
4. Operating supply voltage Vcc : 4.5～17V
5. TTL and CMOS compatible output
6. Wide gap between LED and detector (5mm)

■ Applications

1. Copiers, printers, facsimiles
2. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

7

■ Absolute Maximum Ratings (T_a=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=8mA	—	1.14	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=0	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=8mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=8mA	—	1.0	3.0	mA
Transfer characteristics	*3"Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	1.5	8.0	mA
	*4Hysteresis		I_{FHL}/I_{FLH}		0.55	0.75	0.95	—
	Response time	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=8mA, R_L=280Ω	—	3	9	μs
		"High→Low" propagation time	t_{PHL}		—	5	15	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output goes from low to high.
*4 I_{FHL} represents forward current when output goes from high to low.
Hysteresis stands for I_{FHL}/I_{FLH}.

In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temperature	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0～+70°C	—	16.0	mA
Forward current	I_F		10.0	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

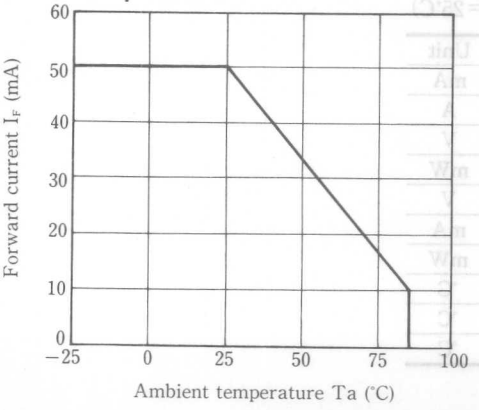


Fig. 2 Output Power Dissipation vs. Ambient Temperature

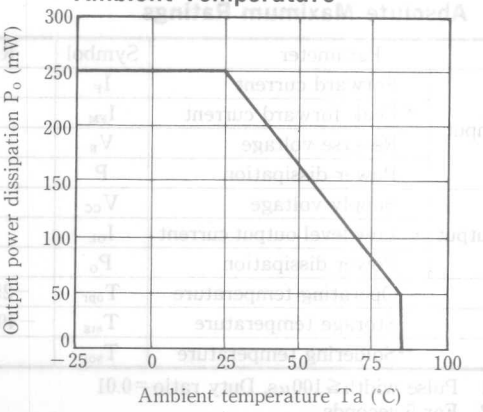


Fig. 3 Low Level Output Current vs. Ambient Temperature

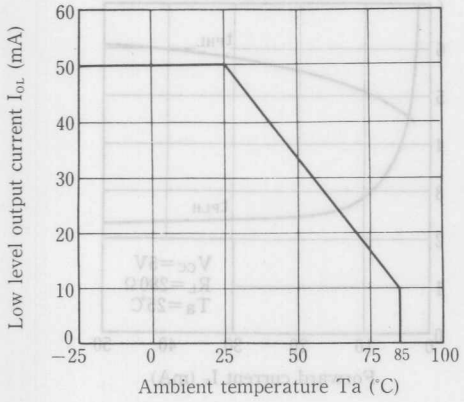


Fig. 4 Forward Current vs. Forward Voltage

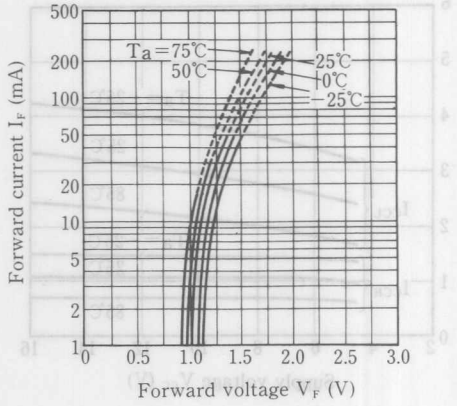


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

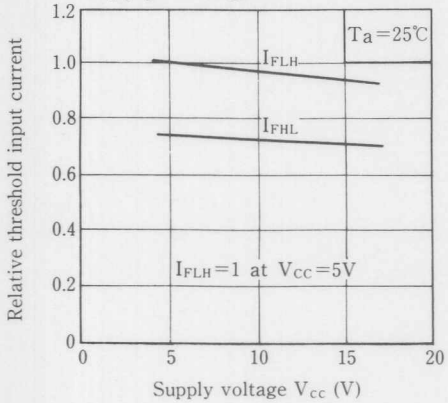


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

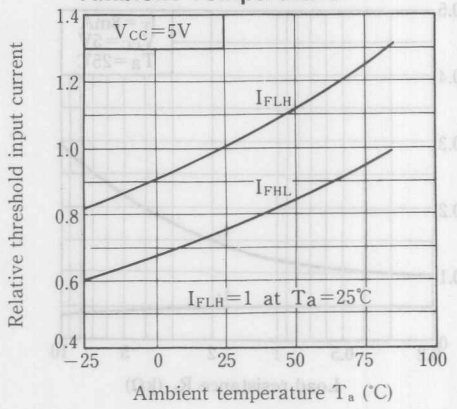


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

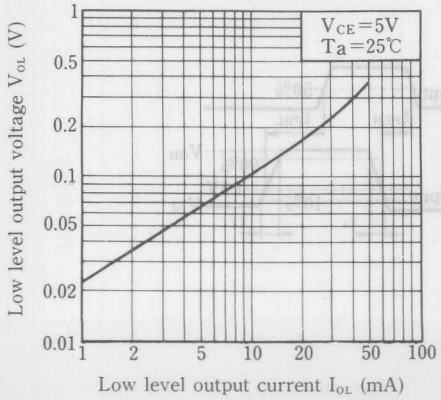
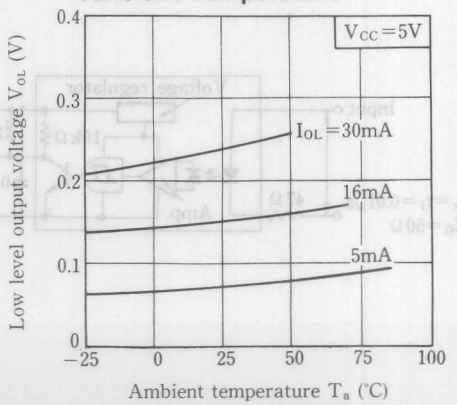


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



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Fig. 9 Supply Current vs. Supply Voltage

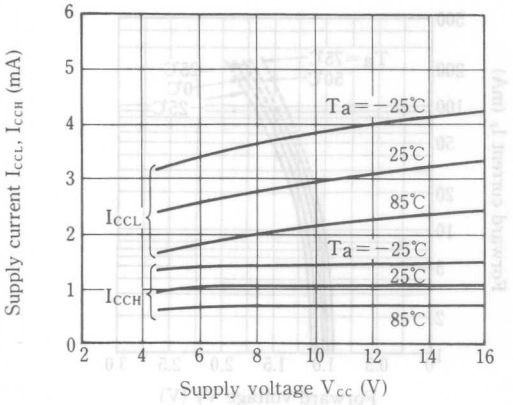


Fig. 10 Propagation Time vs. Forward Current

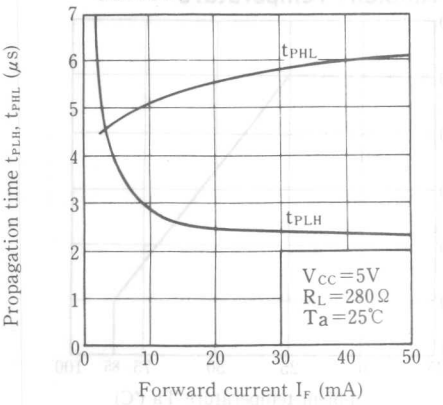
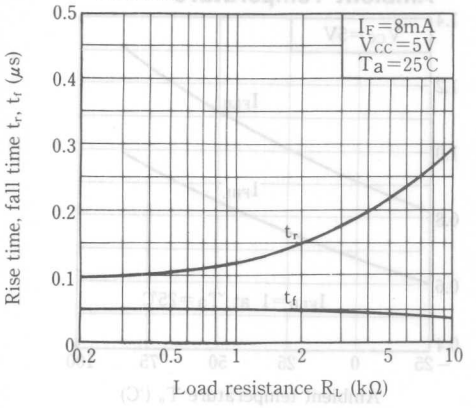
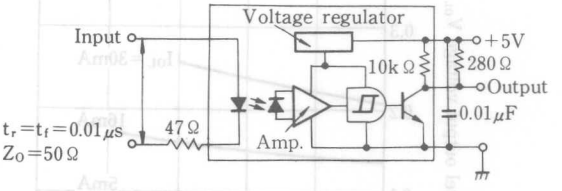
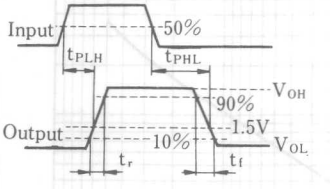


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





GP1A15 High Sensing Accuracy Type OPIC Photointerrupter

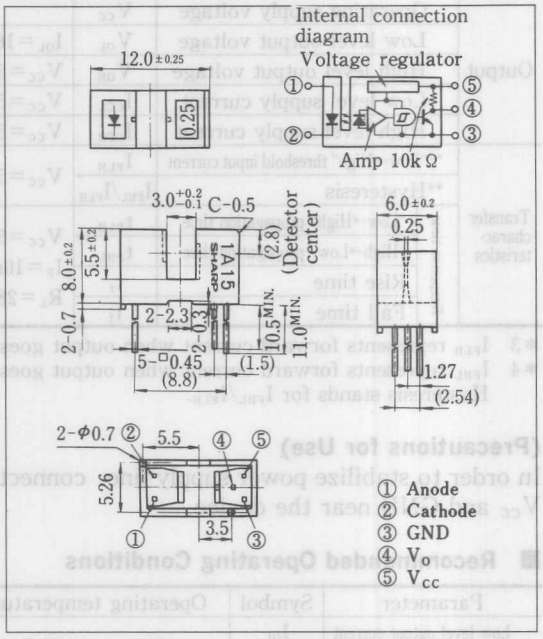
■ Features

1. High sensing accuracy (slit width : 0.25mm)
2. Built-in Schmidt trigger circuit
3. Low threshold input current (I_{FLH} : MAX. 10mA)
4. Low level supply current (I_{CCL} : MAX. 5mA)
5. Operating supply voltage V_{CC} : 4.5~17V
6. TTL and CMOS compatible output

■ Applications

1. Floppy disk drives
2. Copiers, printers, facsimiles
3. Opetoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

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■ Absolute Maximum Ratings (T_a=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
	Operating temperature	T_{opr}	−25~+85	°C
	Storage temperature	T_{stg}	−40~+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=10mA	—	1.15	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=0	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=10mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=10mA	—	1.0	3.0	mA
Transfer characteristics	*3"Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	2.5	10	mA
	*4Hysteresis		I_{FHL}/I_{FLH}		0.55	0.75	0.95	—
	Response time	"Low→High" propagation time	t_{PLH}	V_{CC}=5V I_F=10mA R_L=280Ω	—	3	9	μs
		"High→Low" propagation time	t_{PHL}		—	5	15	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output goes from low to high.
*4 I_{FHL} represents forward current when output goes from high to low.
Hysteresis stands for I_{FHL}/I_{FLH}.

(Precautions for Use)

In order to stabilize power supply line. connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temperature	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0～+70°C	—	16.0	mA
Forward current	I_F		12.5	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

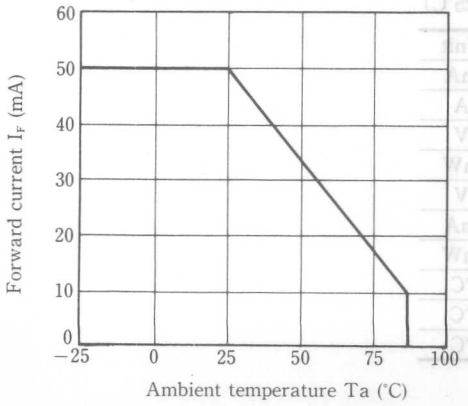


Fig. 2 Output Power Dissipation vs. Ambient Temperature

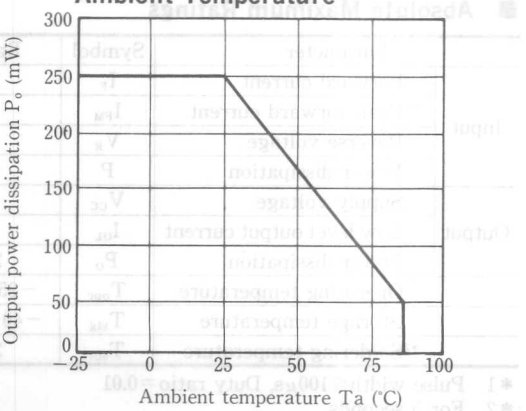


Fig. 3 Low Level Output Current vs. Ambient Temperature

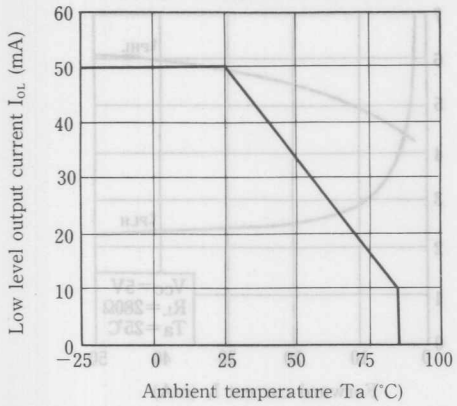


Fig. 4 Forward Current vs. Forward Voltage

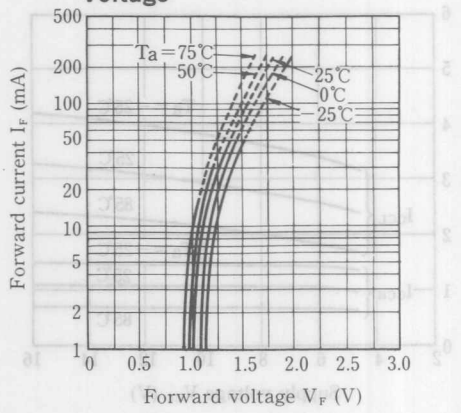


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

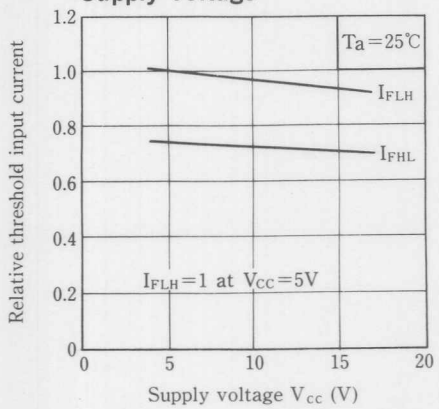


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

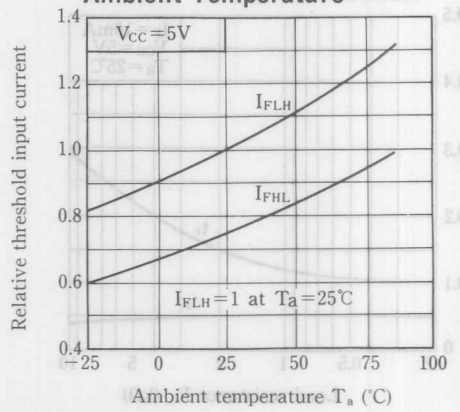


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

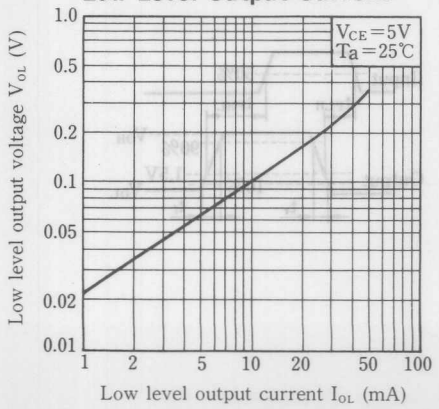
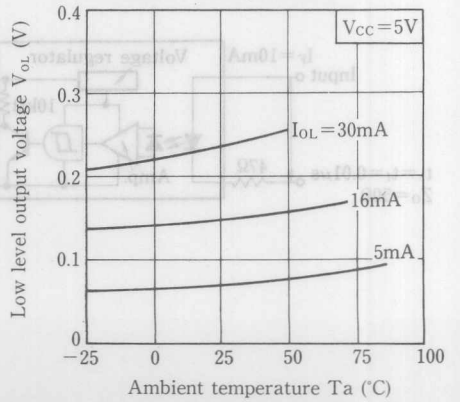


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



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Fig. 9 Supply Current vs. Supply Voltage

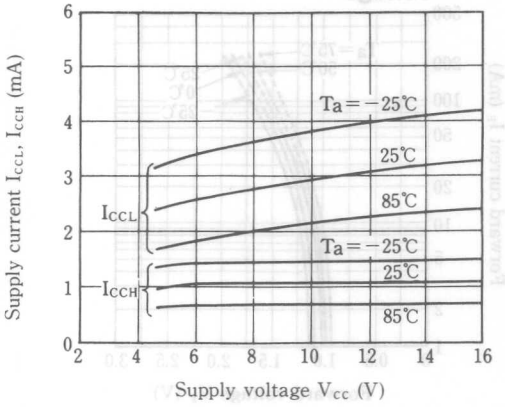


Fig. 10 Propagation Time vs. Forward Current

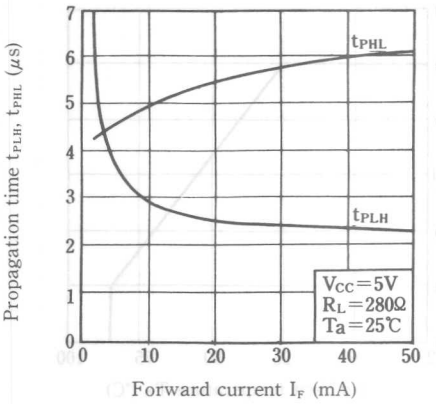
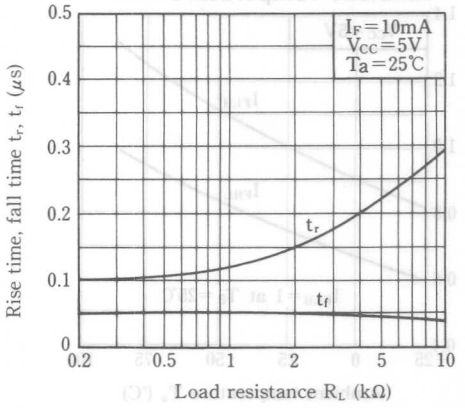
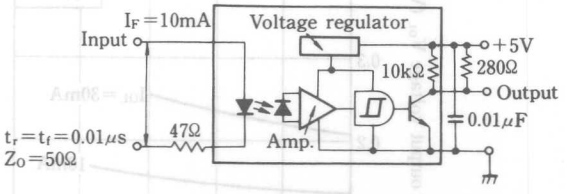
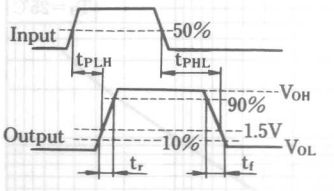


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





GP1A16R OPIC Photointerrupter with Encoder Function

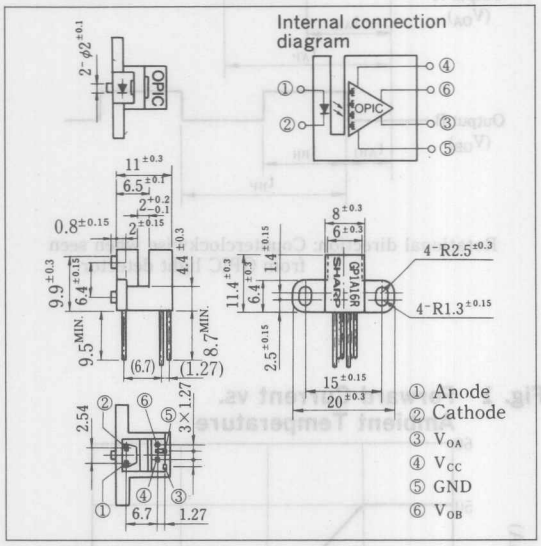
■ Features

1. 2-phase (A, B) digital output
2. High sensing accuracy
   (Disk slit pitch: 0.7mm)
3. TTL compatible output
4. Compact

■ Applications

1. Electronic typewriters, printers
2. Robots
3. Numerical control machines

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	7	V
	Low level output current	I_{OL}	20	mA
	Power dissipation	P_O	250	mW
	Operating temperature	T_{opr}	0～+70	°C
	Storage temperature	T_{stg}	−40～+80	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

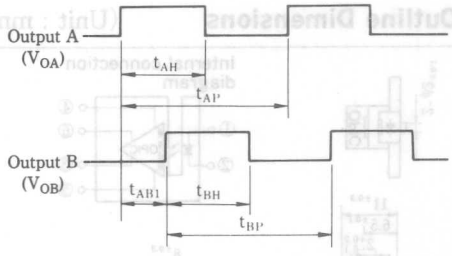
■ Electro-optical Characteristics (Unless otherwise specified, Ta=0～+70°C)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	Ta=25°C, I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	Ta=25°C, V_R=3V	—	—	10	μA
Output	Operating supply voltage	V_{CC}		4.5	5.0	5.5	V
	High level output voltage	V_{OH}	V_{CC}=5V, I_F=20mA*3	2.4	4.9	—	V
	Low level output voltage	V_{OL}	I_{OL}=8mA, V_{CC}=5V, I_F=20mA*3	—	0.1	0.4	V
	Supply current	I_{CC}	I_F=20mA, V_{CC}=5V*4	—	5	20	mA
Transfer characteristics	Duty ratio	D_A*5	V_{CC}=5V, I_F=20mA*3	0.20	0.50	0.80	—
		D_B*5	f=2.5kHz	0.20	0.50	0.80	
	Response frequency	$f_{MAX.}$	V_{CC}=5V, I_F=20mA*3	—	—	10	kHz

*3 Measured under the condition shown in Measurement Conditions
*4 In the condition that outputs A and B are low level.
*5 $D_A=\frac{t_{AH}}{t_{AP}}$, $D_B=\frac{t_{BH}}{t_{BP}}$

7

■ Output Waveforms



Rotational direction: Counterclockwise when seen from OPIC light detector

Fig. 1 Forward Current vs. Ambient Temperature

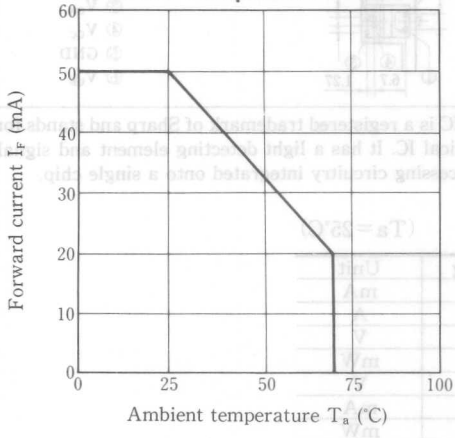


Fig. 2 Output Power Dissipation vs. Ambient Temperature

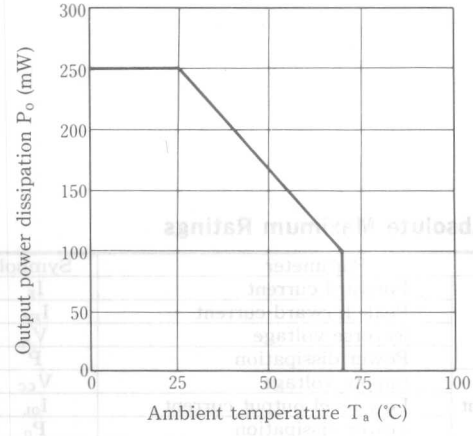


Fig. 3 Duty Ratio vs. Frequency

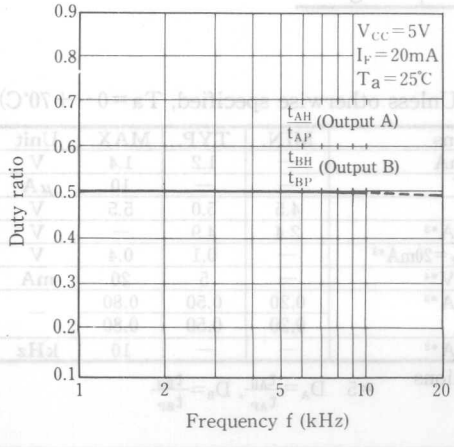


Fig. 4 Phase Difference vs. Frequency

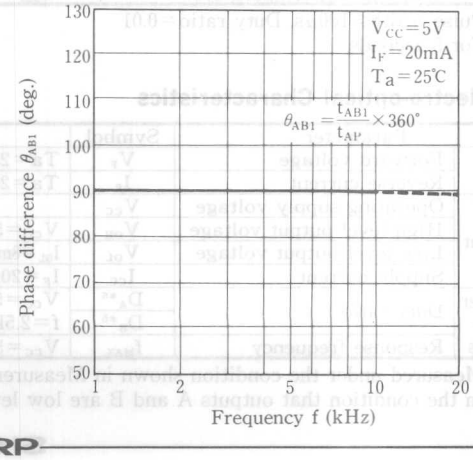


Fig. 5 Duty Ratio vs. Ambient Temperature

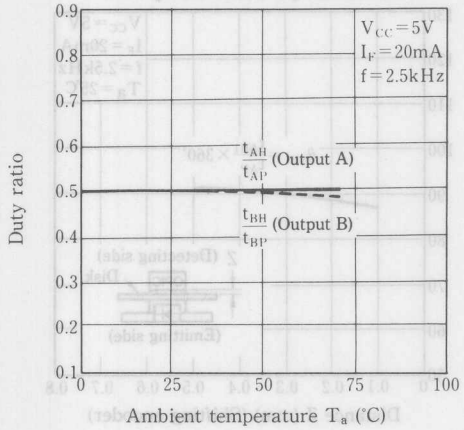


Fig. 6 Phase Difference vs. Ambient Temperature

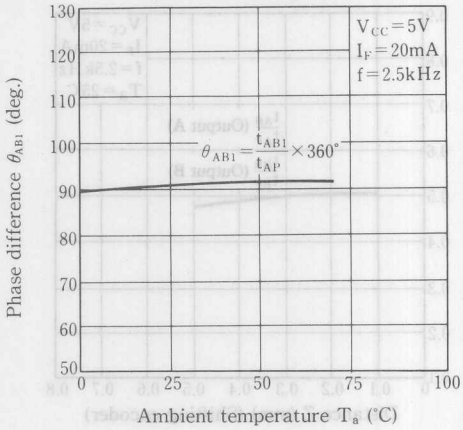


Fig. 7 Duty Ratio vs. Distance (X direction)

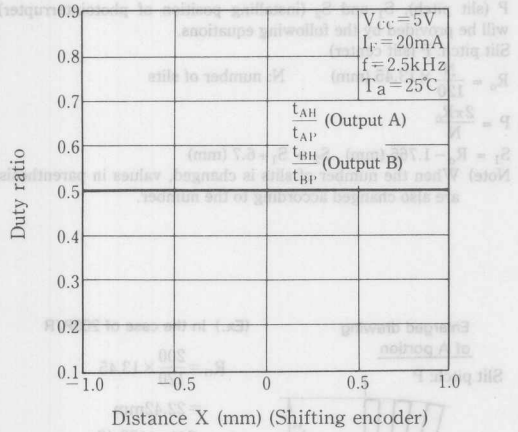


Fig. 8 Phase Difference vs. Distance (X direction)

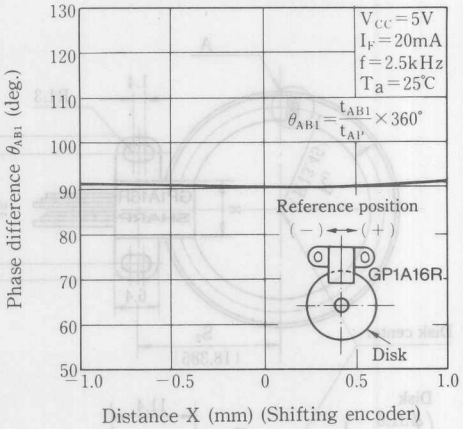


Fig. 9 Duty Ratio vs. Distance (Y direction)

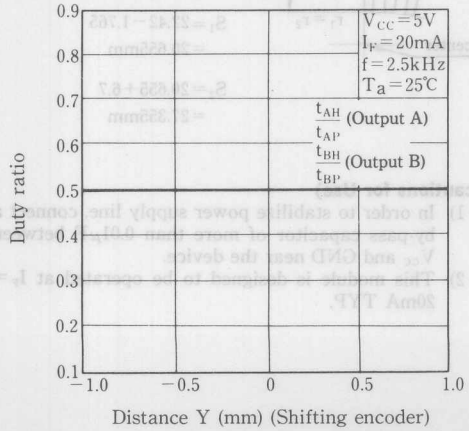
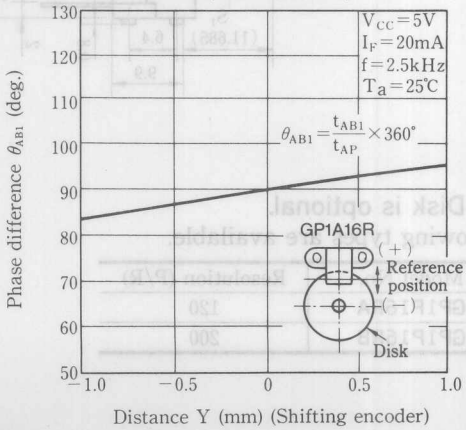


Fig. 10 Phase Difference vs. Distance (Y direction)



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Fig. 11 Duty Ratio vs. Distance (Z direction)

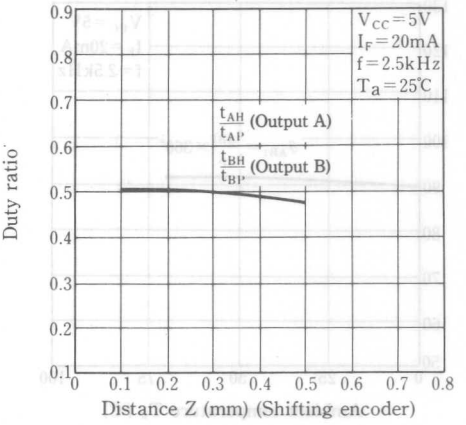
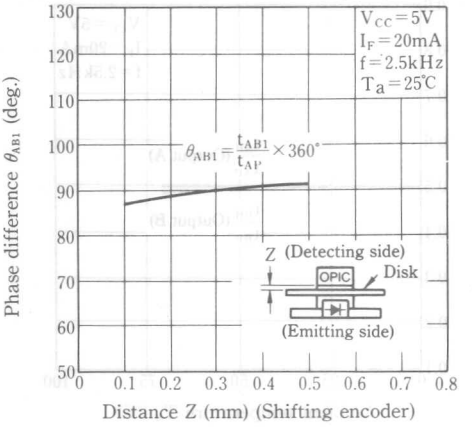
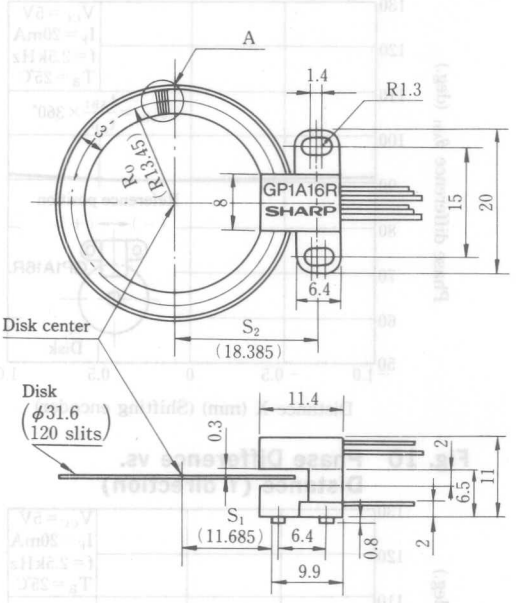


Fig. 12 Phase Difference vs. Distance (Z direction)



■ Measurement Conditions



<Basic Design>

R_O (distance between the disk center and half point of a slit), P (slit pitch), S_1 and S_2 (installing position of photointerrupter) will be provided by the following equations.

Slit pitch: P (slit center)

$$R_o = \frac{N}{120}\times 13.45 \text{ (mm)} \qquad N: \text{number of slits}$$

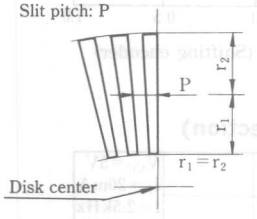
$$P = \frac{2\pi R_o}{N}$$

$S_1 = R_o - 1.765$ (mm) $S_2 = S_1 + 6.7$ (mm)

Note) When the number of slits is changed, values in parenthesis are also changed according to the number.

Enlarged drawing of A portion

Slit pitch: P



(Ex.) In the case of 200P/R

$$R_O = \frac{200}{120}\times 13.45$$

$$= 22.42\text{mm}$$

$$P = \frac{2\times\pi\times 22.42}{200}$$

$$= 0.704\text{mm}$$

$S_1 = 22.42 - 1.765$

$= 20.655$mm

$S_2 = 20.655 + 6.7$

$= 27.355$mm

■ Disk is optional.

Following types are available.

Model No.	Resolution (P/R)
GP1P16RA	120
GP1P16RB	200

(Precautions for Use)

Note 1) In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

Note 2) This module is designed to be operated at I_F = 20mA TYP.

GP1A17 Wide Gap Type, OPIC Photointerrupter

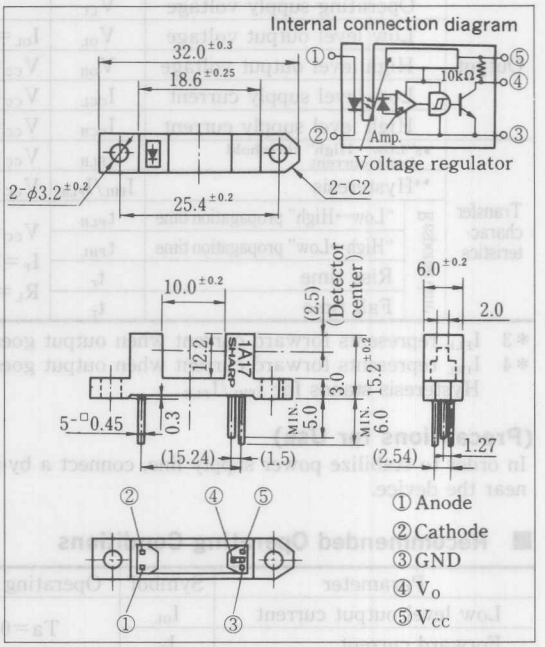
■ Features

1. Built-in Schmidt trigger circuit
2. Wide gap between light emitter and detector (10mm)
3. Operating supply voltage V_{CC}: 4.5~17V
4. TTL and CMOS compatible output

■ Applications

1. Copiers
2. Analyzers, measuring instruments, etc.

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

7

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
	Operating temperature	T_{opr}	−25~+85	°C
	Storage temperature	T_{stg}	−40~+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=7mA	—	1.13	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=0	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=7mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=7mA	—	1.0	3.0	mA
Transfer characteristics	*3"Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	3.0	7.0	mA
	*4Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V	0.55	0.65	0.95	—
	Response time	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=7mA, R_L=280Ω	—	3	9	μs
		"High→Low" propagation time	t_{PHL}		—	5	15	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output goes from low to high.
*4 I_{FHL} represents forward current when output goes from high to low.
Hysteresis stands for I_{FHL}/I_{FLH}.

(Precautions for Use)

In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temperature	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0～+70°C	—	16	mA
Forward current	I_F		10	20	mA

Fig. 1 Forward Current vs. Ambient Temperature

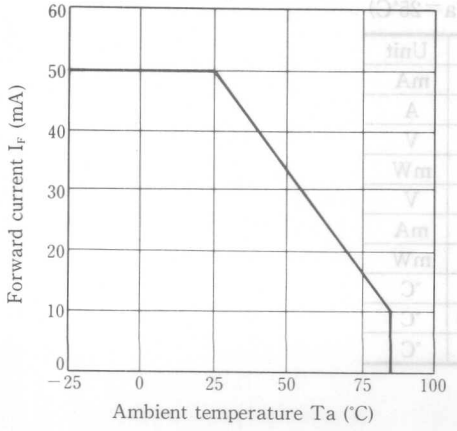


Fig. 2 Output Power Dissipation vs. Ambient Temperature

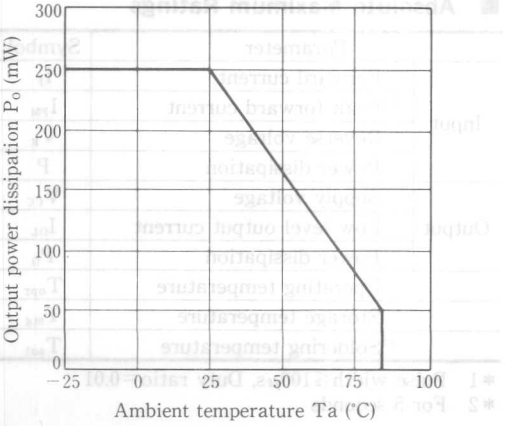


Fig. 3 Low level Output Current vs. Ambient Temperature

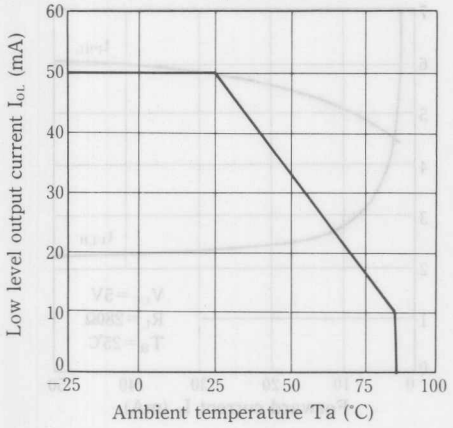


Fig. 4 Forward Current vs. Forward Voltage

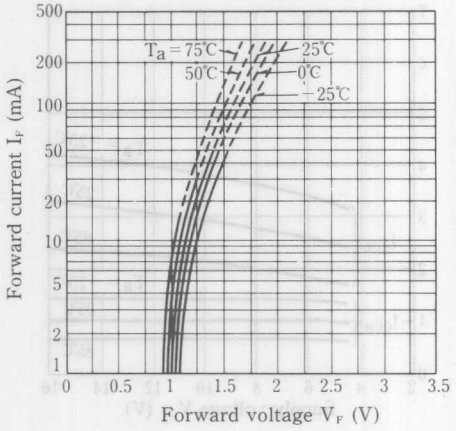


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

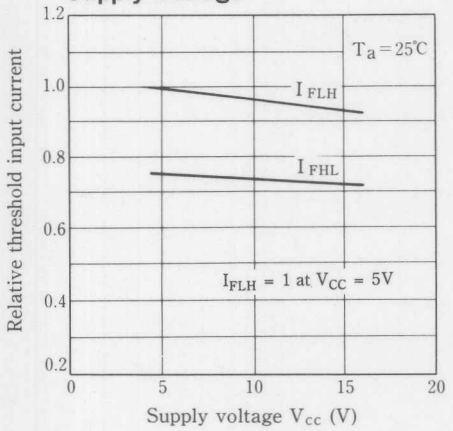


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

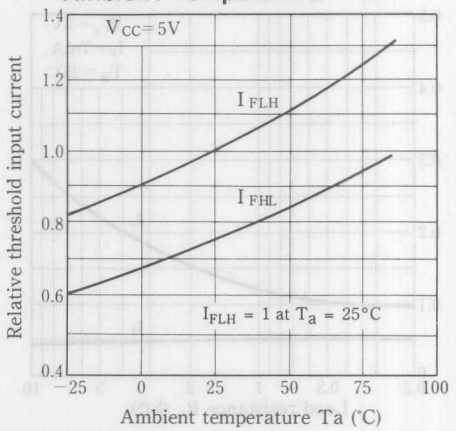


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

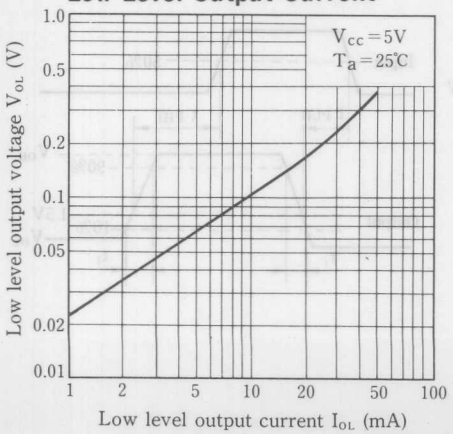
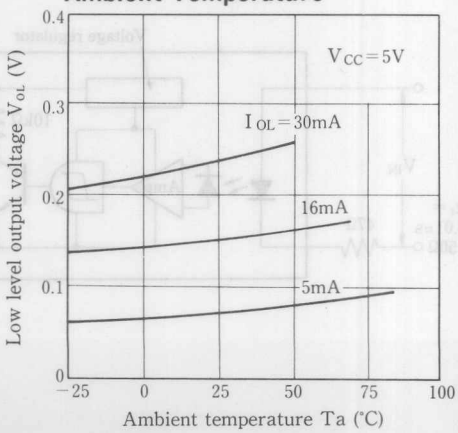


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



7

Fig. 9 Supply Current vs. Supply Voltage

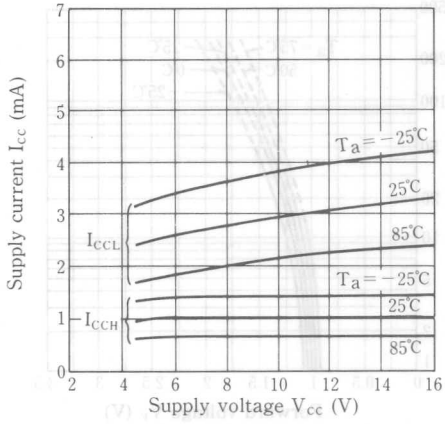


Fig. 10 Propagation Time vs. Forward Current

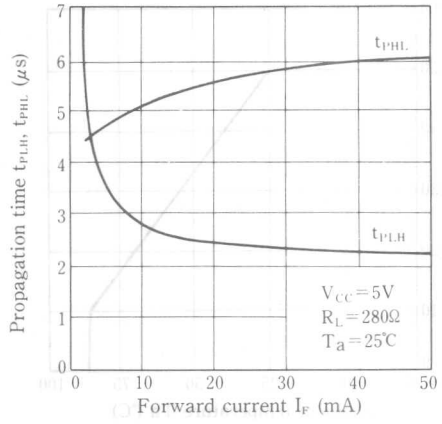
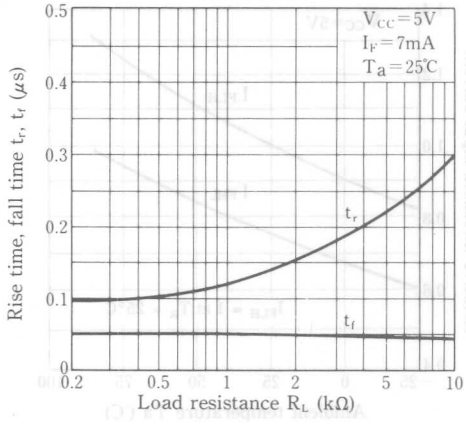
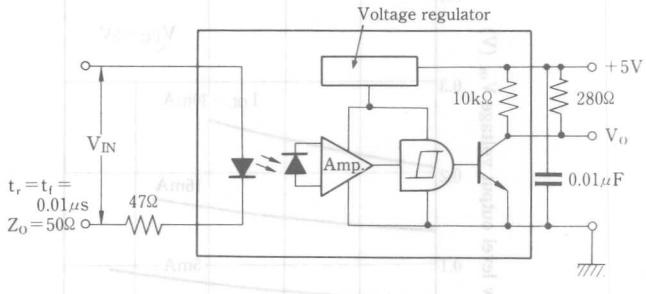
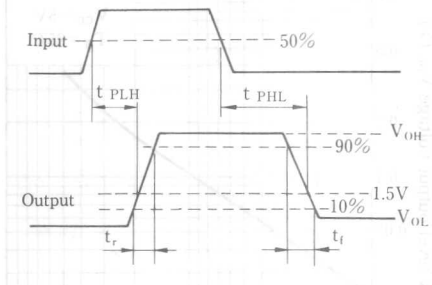


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





GP1A18 High Sensitivity Type OPIC Photointerrupter

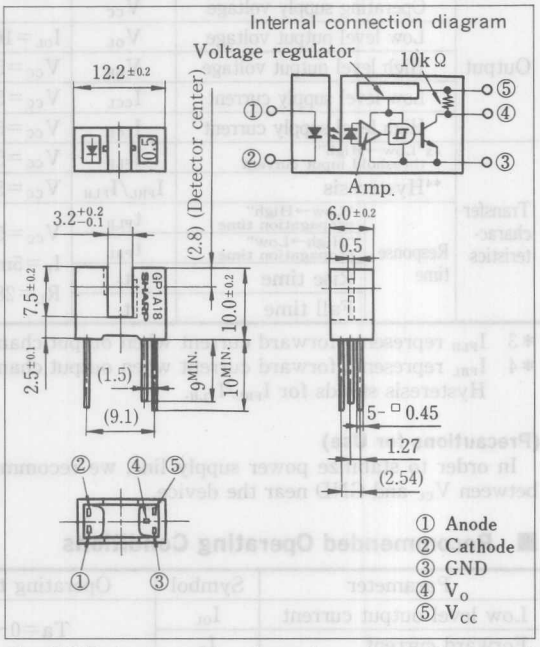
■ Features

1. Built-in Schmidt trigger circuit
2. Low threshold input current (I_{FLH} : MAX. 5mA)
3. Operating supply voltage V_{CC} : 4.5~17V
4. High sensing accuracy (Slit width : 0.5mm)
5. TTL and CMOS compatible output
6. Easy to mount on PWB due to compact and lightweight

■ Applications

1. Copiers, printers, facsimiles
2. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

7

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
Operating temperature		T_{opr}	−25~+85	°C
Storage temperature		T_{stg}	−40~+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=5mA	—	1.1	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=0	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=5mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=5mA	—	1.0	3.0	mA
Transfer characteristics	*3"Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	1.0	5.0	mA
	*4Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V	0.55	0.75	0.95	
	Response time	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=5mA, R_L=280Ω	—	3	9	μs
		"High→Low" propagation time	t_{PHL}		—	5	15	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output changes from low to high.
*4 I_{FHL} represents forward current when output changes from high to low.
Hysteresis stands for I_{FHL}/I_{FLH}.

(Precautions for Use)

In order to stabilize power supply line, we recommend to connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temperature	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0~+70°C	—	16.0	mA
Forward current	I_F		10.0	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

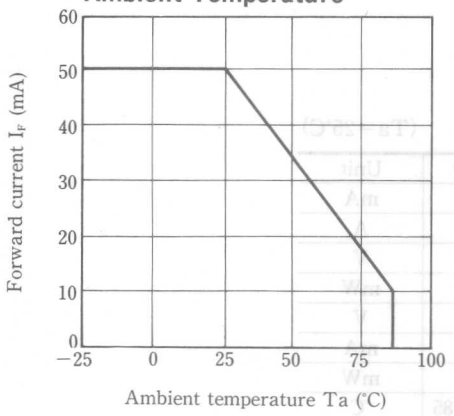


Fig. 2 Output Power Dissipation vs. Ambient Temperature

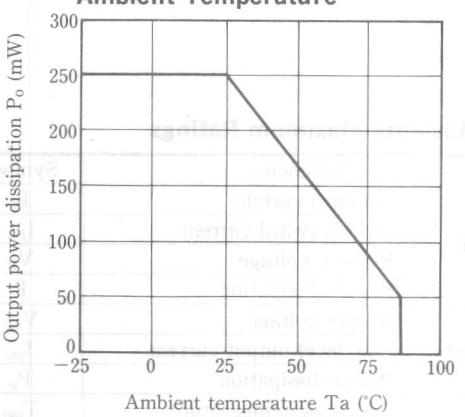


Fig. 3 Low Level Output Current vs. Ambient Temperature

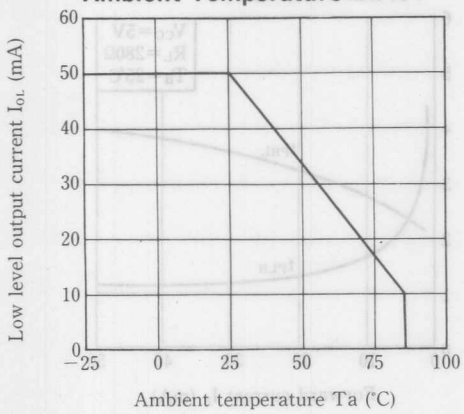


Fig. 4 Forward Current vs. Forward Voltage

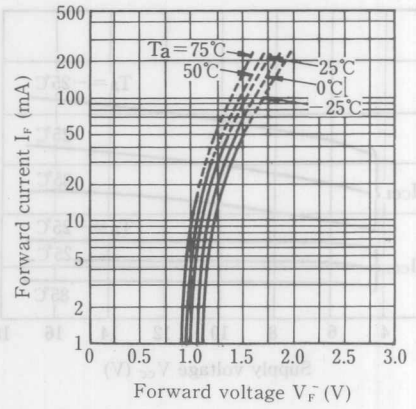


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

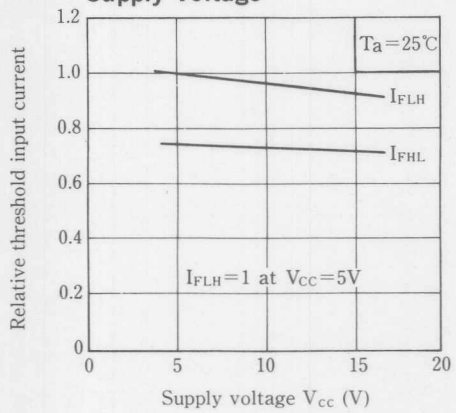


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

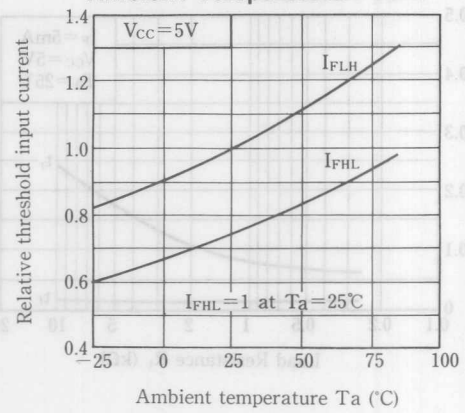


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

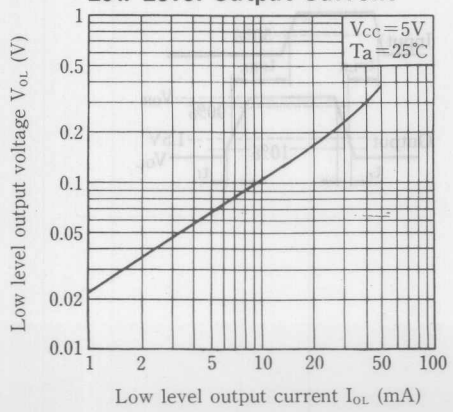
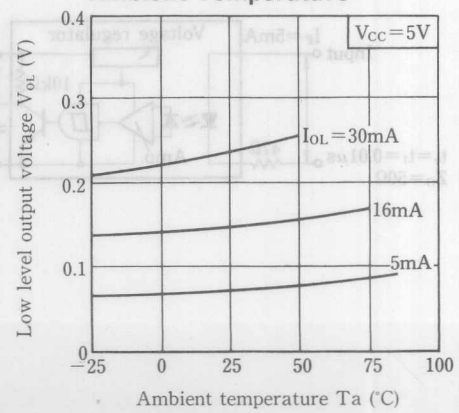


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



7

Fig. 9 Supply Current vs. Supply Voltage

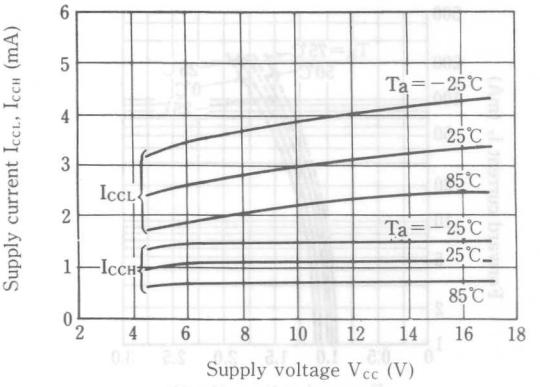


Fig. 10 Propagation Time vs. Forward Current

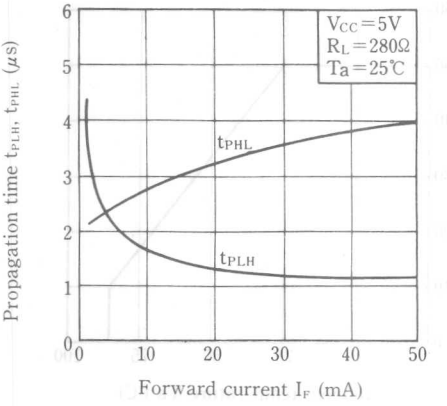
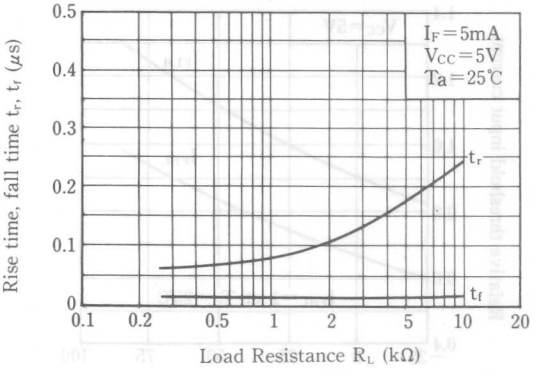
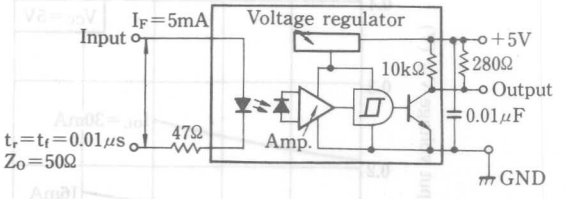
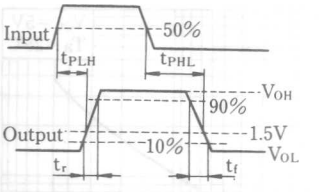


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





GP1A18LC High Sensitivity OPIC Photointerrupter

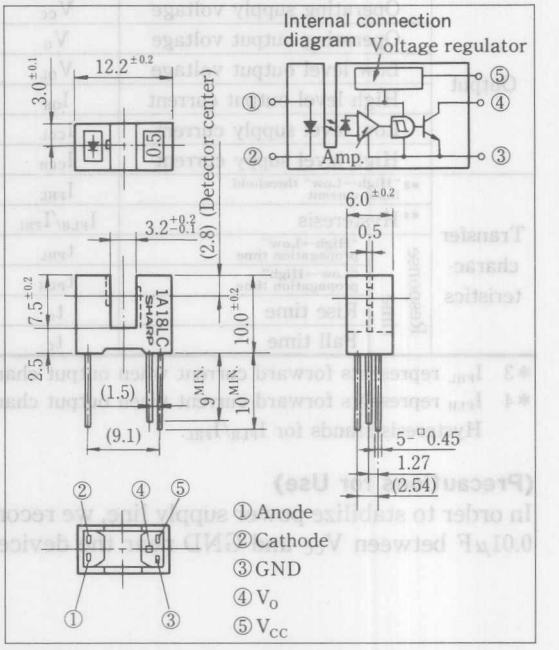
■ Features

1. Built-in Schmidt trigger circuit
2. Open collector output
3. Low threshold input current (I_{FHL} : MAX. 5mA)
4. Operating supply voltage V_{CC} : 4.5～17V
5. High sensing accuracy (Slit width : 0.5mm)

■ Applications

1. Copiers, printers, facsimiles
2. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto single chip.

7

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	35	V
	Output voltage	V_O	35	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2 Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=10mA	—	1.2	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10.0	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17.0	V
	Operating output voltage		V_O		0	—	30.0	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=5mA	—	0.15	0.4	V
	High level output current		I_{OH}	V_{CC}=5V, V_O=5V	—	—	100	μA
	Low level supply current		I_{CCL}	V_{CC}= 5 V, I_F=5mA	—	2.0	4.5	mA
	High level suppy current		I_{CCH}	V_{CC}=5V, I_F=0	—	1.0	3.0	mA
Transfer characteristics	*3 "High→Low" threshold input current		I_{FHL}	V_{CC}=5V, R_L=280Ω	—	1.5	5.0	mA
	*4 Hysteresis		I_{FLH}/I_{FHL}	V_{CC}=5V	0.55	0.75	0.95	
	Response time	"High→Low" propagation time	t_{PHL}	V_{CC}=5V, I_F=5mA, R_L=280Ω	—	3.0	9.0	μs
		"Low→High" propagation time	t_{PLH}		—	5.0	15.0	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FHL} represents forward current when output changes from high to low.
*4 I_{FLH} represents forward current when output changes from low to high.
Hysteresis stands for I_{FLH}/I_{FHL}.

(Precautions for Use)

In order to stabilize power supply line, we recommend to connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

Fig. 1 Forward Current vs. Ambient Temperature

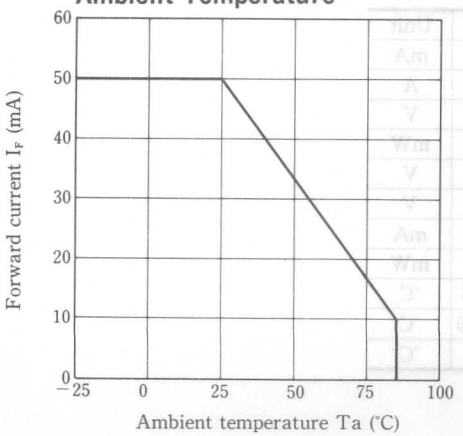


Fig. 2 Output power Dissipation vs. Ambient Temperature

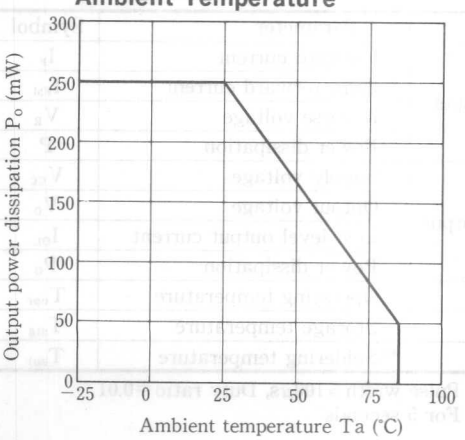


Fig. 3 Low Level Output Current vs. Ambient Temperature

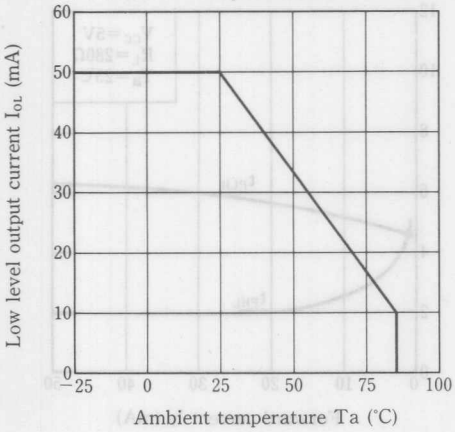


Fig. 4 Forward Current vs. Forward Voltage

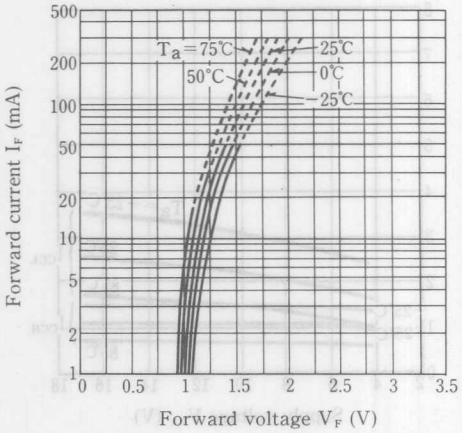


fig. 5 Relative Threshold Input Current vs. Supply Voltage

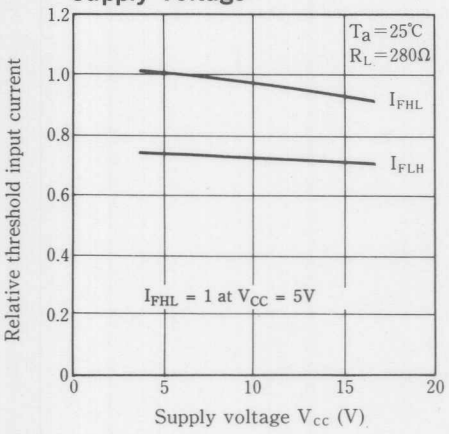


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

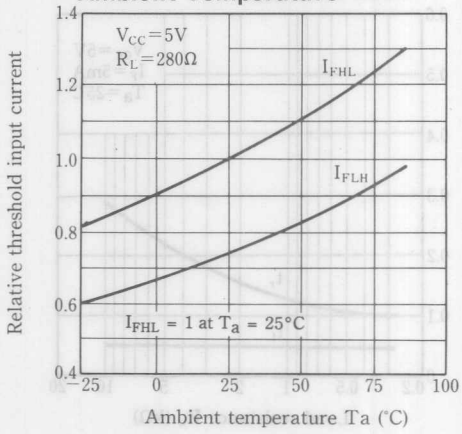


Fig. 7 Low Level Output Voltage vs. Low Level Output current

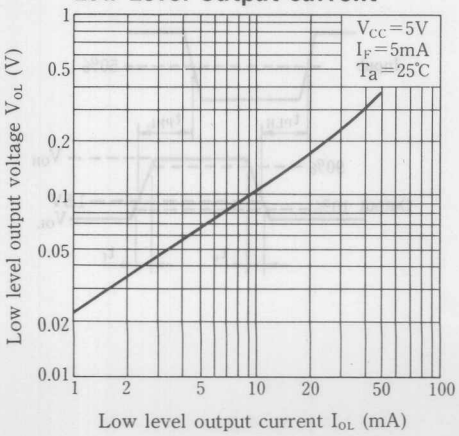
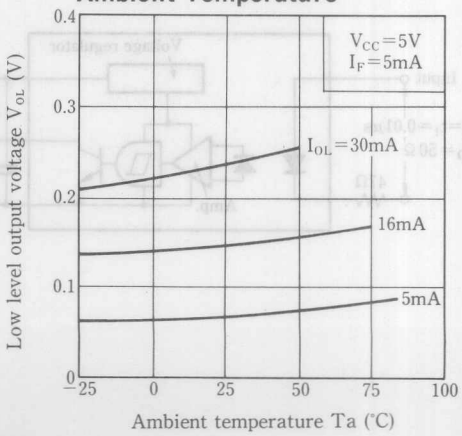


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



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Fig. 9 Supply Current vs. Supply Voltage

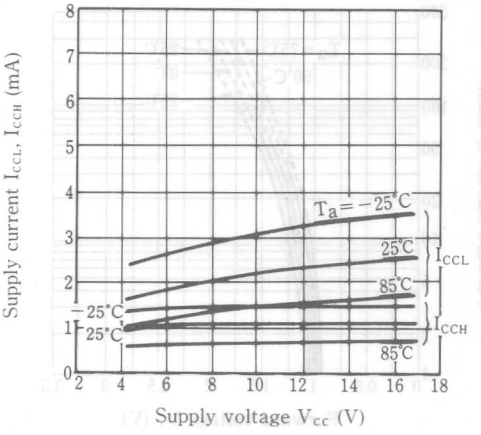


Fig. 10 Propagation Time vs. Forward Current

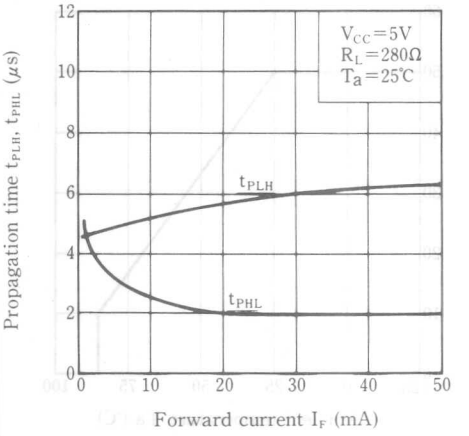
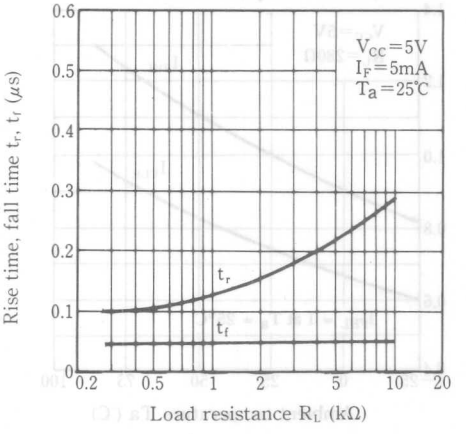
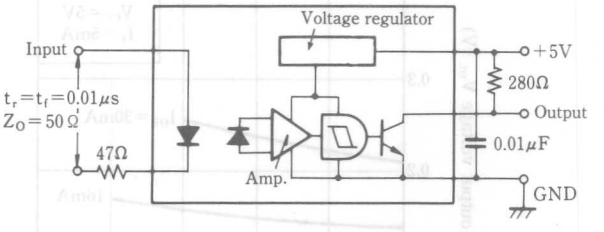
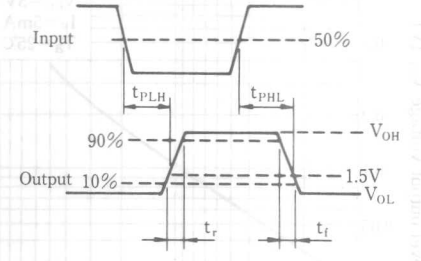


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





GP1A18LR High Sensitivity OPIC Photointerrupter

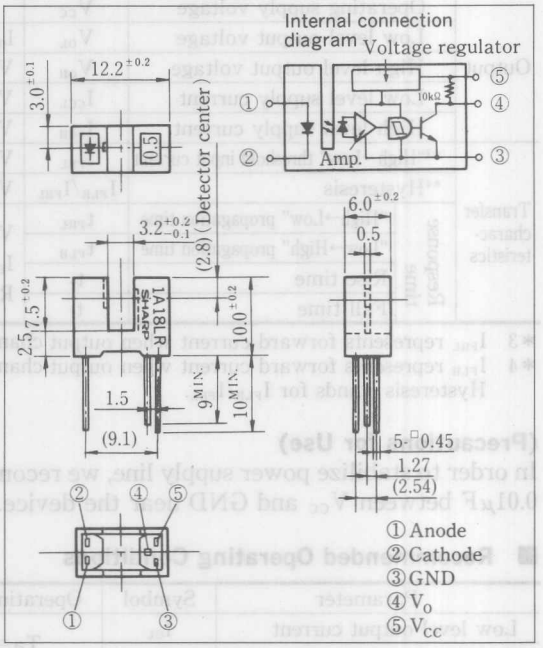
■ Features

1. Built-in Schmidt trigger circuit
2. Low threshold input current (I_{FHL}: MAX. 5mA)
3. Operating supply voltage V_{CC}: 4.5~17V
4. High sensing accuracy (Slit width: 0.5mm)
5. TTL and CMOS compatible output
6. PWB direct mounting type package

■ Applications

1. Copiers, printers, facsimiles
2. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

7

■ Absolute Maximum Ratings (Ta = 25℃)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{cc}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	Po	250	mW
Operating temperature		T_{opr}	−25~+85	℃
Storage temperature		T_{stg}	−40~+100	℃
*2Soldering temperature		T_{sol}	260	℃

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25℃)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=10mA	—	1.1	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10.0	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17.0	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=5mA	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=0	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=5mA	—	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=0	—	1.0	3.0	mA
Transfer characteristics	*3"High→Low" threshold input current		I_{FHL}	V_{CC}=5V	—	1.0	5.0	mA
	*4Hysteresis		I_{FLH}/I_{FHL}	V_{CC}=5V	0.55	0.75	0.95	
	Response time	"High→Low" propagation time	t_{PHL}	V_{CC}=5V, I_F=5mA, R_L=280Ω	—	3.0	9.0	μs
		"Low→High" propagation time	t_{PLH}		—	5.0	15.0	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FHL} represents forward current when output changes from high to low.
*4 I_{FLH} represents forward current when output changes from low to high.
Hysteresis stands for I_{FLH}/I_{FHL}.

(Precautions for Use)

In order to stabilize power supply line, we recommend to connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temperature	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0～+70℃	—	16.0	mA
Forward current	I_F		10.0	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

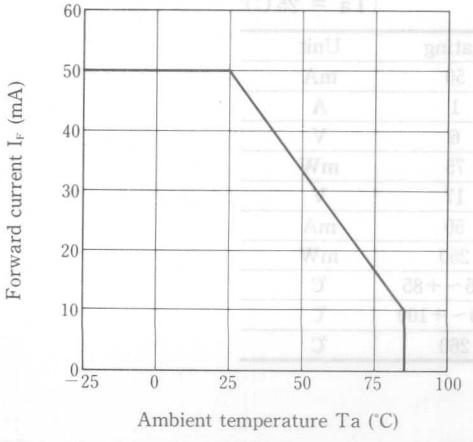


Fig. 2 Output Power Dissipation vs. Ambient Temperature

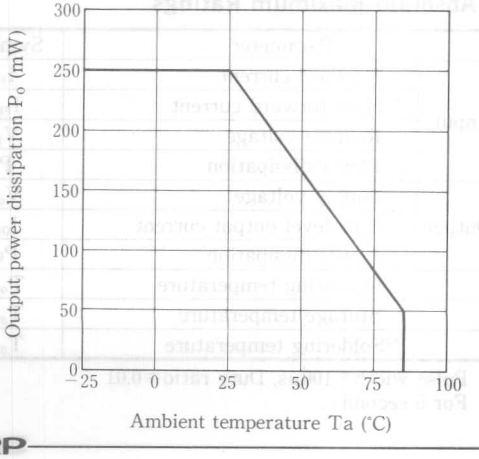


Fig. 3 Low Level Output Current vs. Ambient Temperature

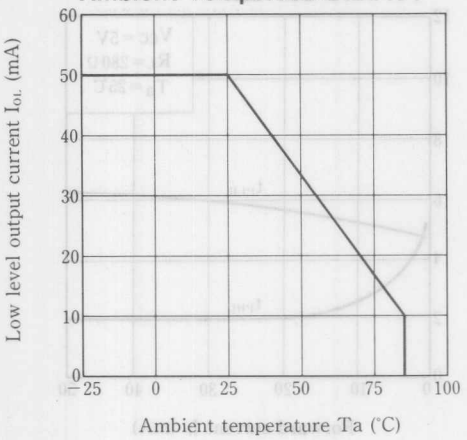


Fig. 4 Forward Current vs. Forward Voltage

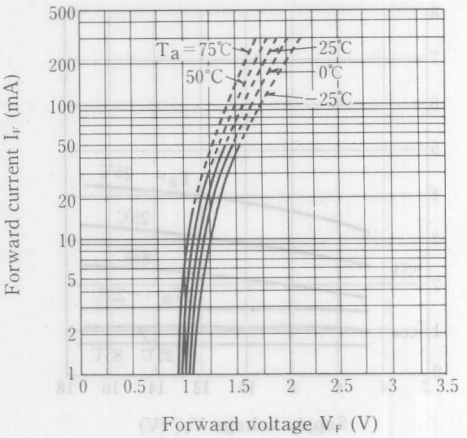


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

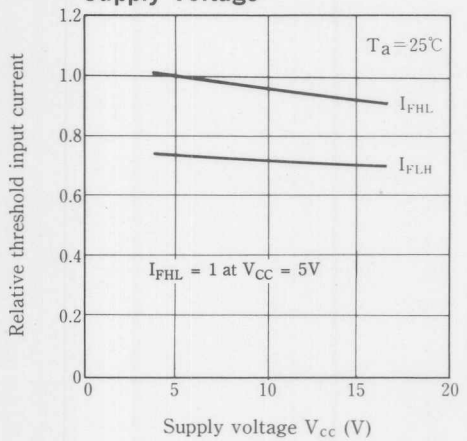


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

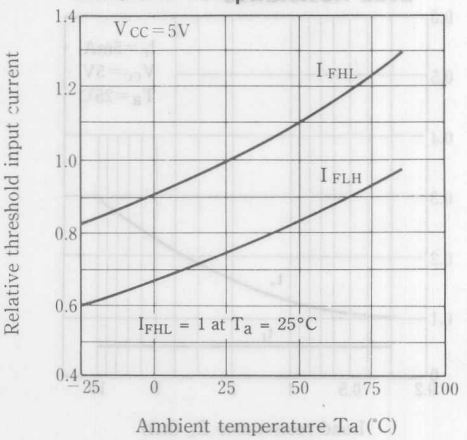


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

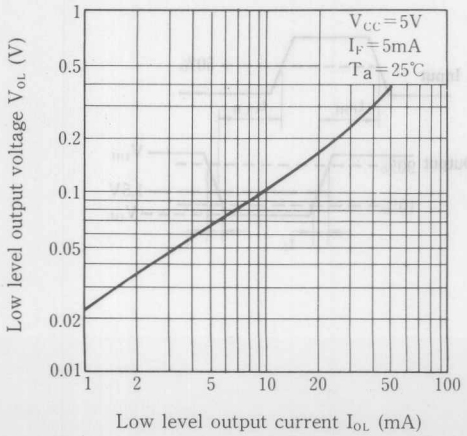
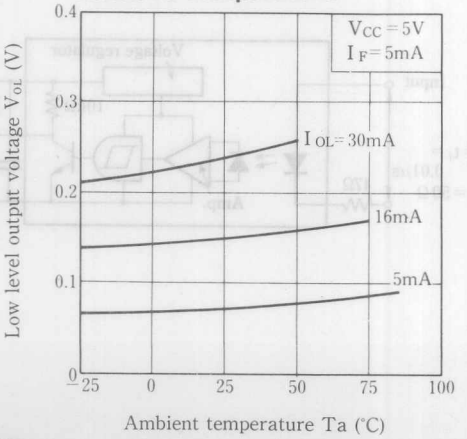


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



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Fig. 9 Supply Current vs. Supply Voltage

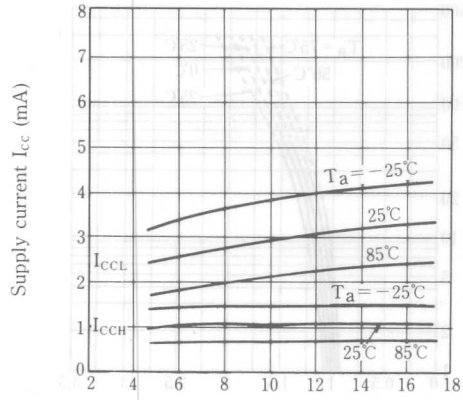


Fig. 10 Propagation Time vs. Forward Current

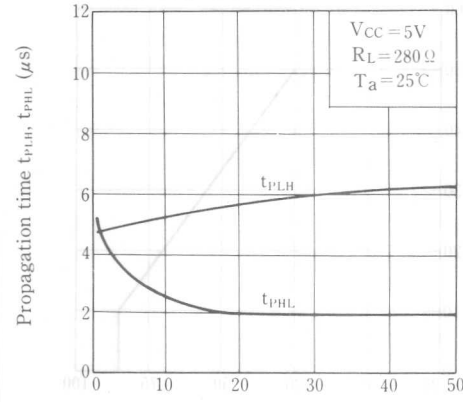
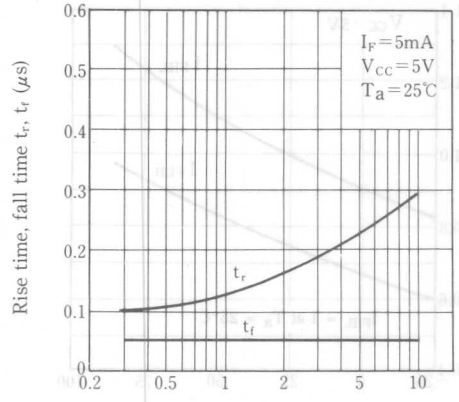
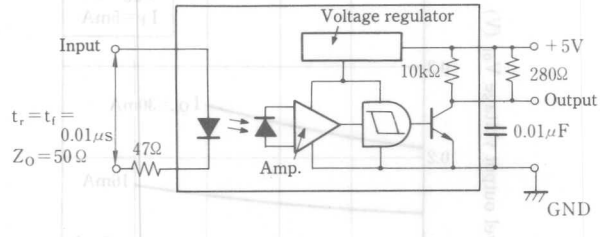
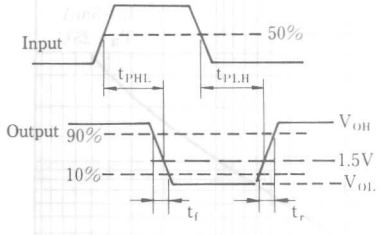


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





GP1A19 High Sensitivity Type OPIC Photointerrupter

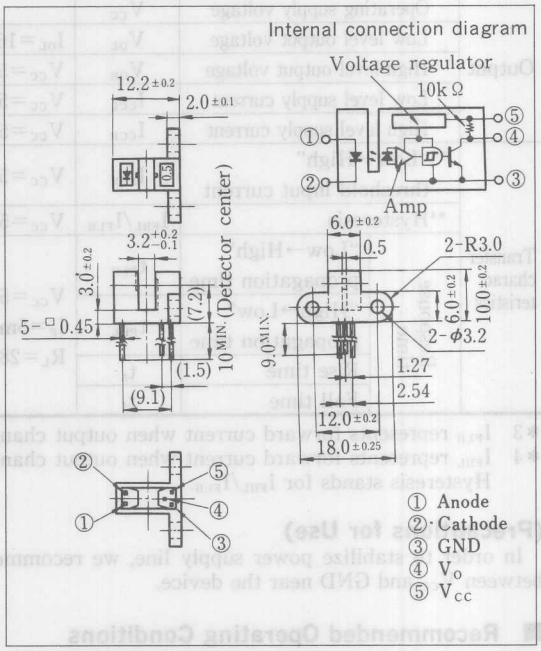
■ Features

1. Built-in Schmidt trigger circuit
2. Low threshold input current (I_{FLH} : MAX. 5mA)
3. Operating supply voltage V_{CC} : 4.5～17V
4. High sensing accuracy (Slit width : 0.5mm)
5. TTL and CMOS compatible output
6. Side-mounting type

■ Applications

1. Copiers, printers, facsimiles
2. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

7

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=5mA	—	1.1	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=0	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=5mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=5mA	—	1.0	3.0	mA
Transfer characteristics	*3"Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	1.0	5.0	mA
	*4Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V	0.55	0.75	0.95	
	Response time	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=5mA, R_L=280Ω	—	3	9	μs
		"High→Low" propagation time	t_{PHL}		—	5	15	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output changes from low to high.
*4 I_{FHL} represents forward current when output changes from high to low.
Hysteresis stands for I_{FHL}/I_{FLH}.

(Precautions for Use)

In order to stabilize power supply line, we recommend to connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temperature	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0～+70°C	—	16.0	mA
Forward current	I_F		10.0	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

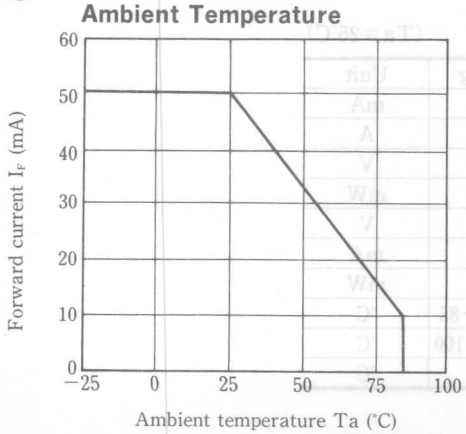


Fig. 2 Output Power Dissipation vs. Ambient Temperature

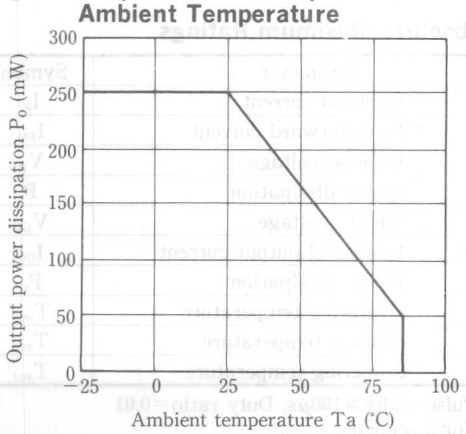


Fig. 3 Low Level Output Current vs. Ambient Temperature

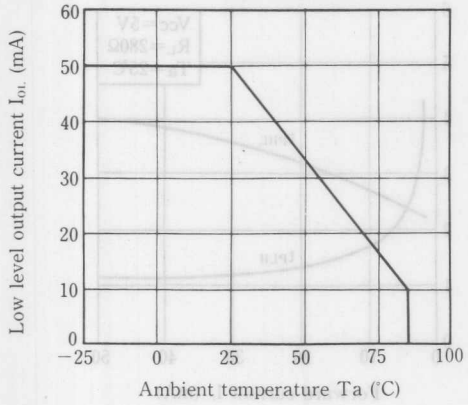


Fig. 4 Forward Current vs. Forward Voltage

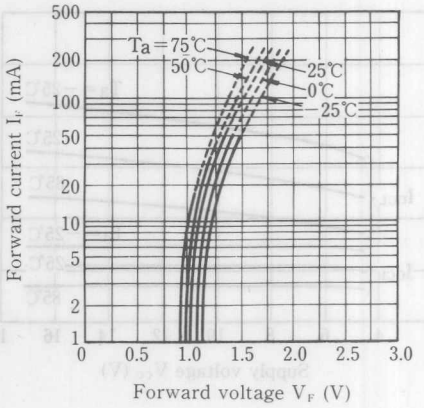


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

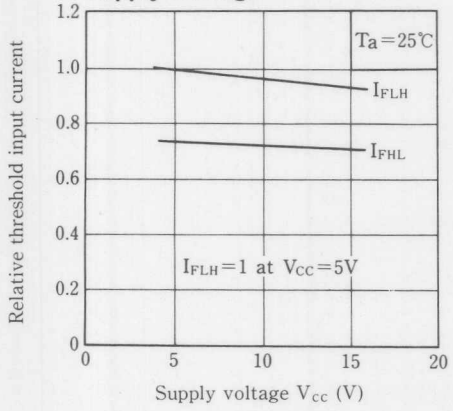


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

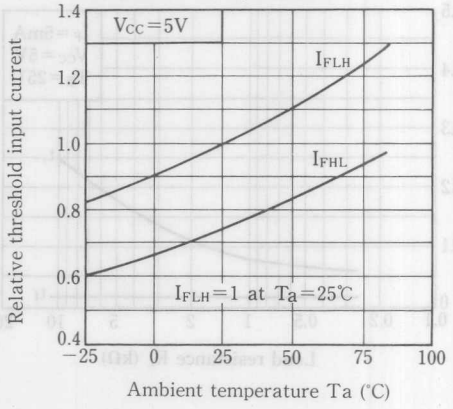


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

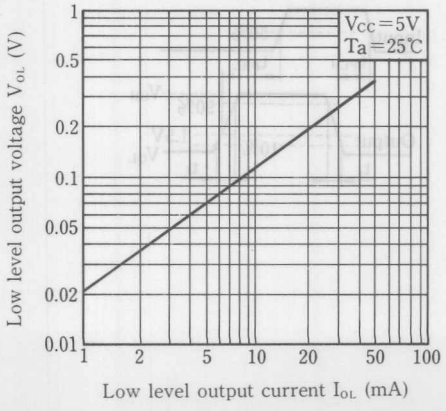
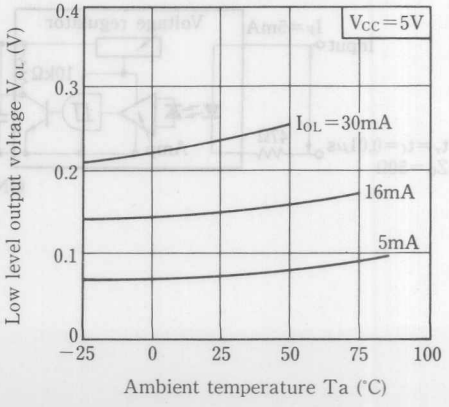


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



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Fig. 9 Supply Current vs. Supply Voltage

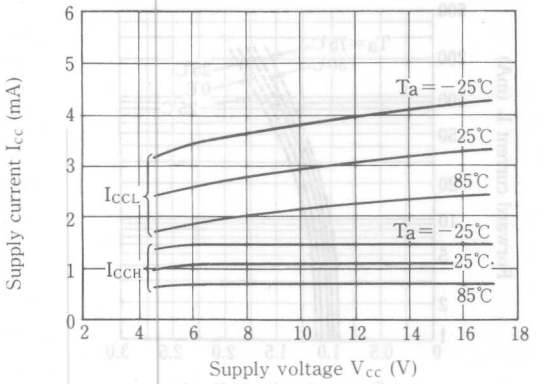


Fig. 10 Propagation Time vs. Forward Current

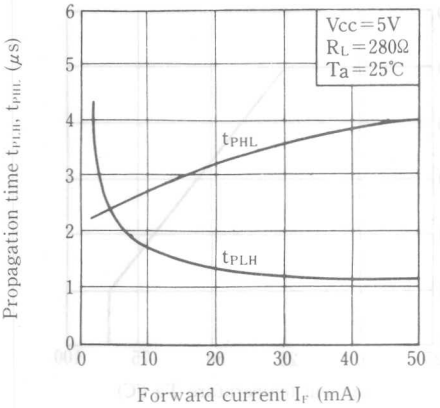
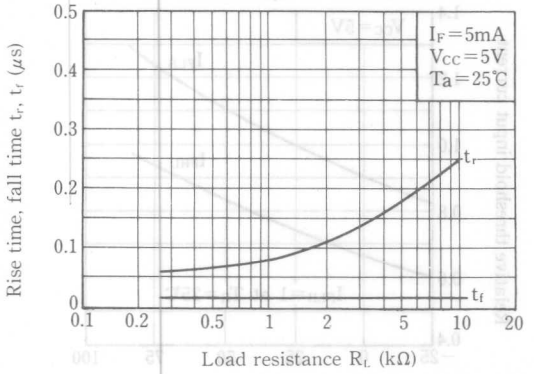
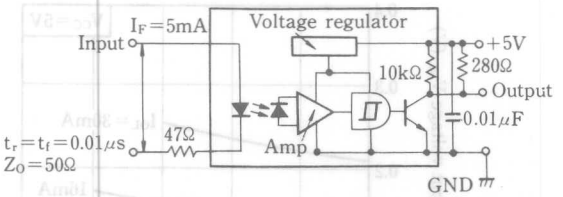
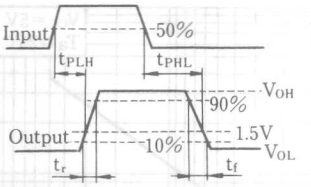


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





GP1A20 OPIC Photointerrupter with Cover Case

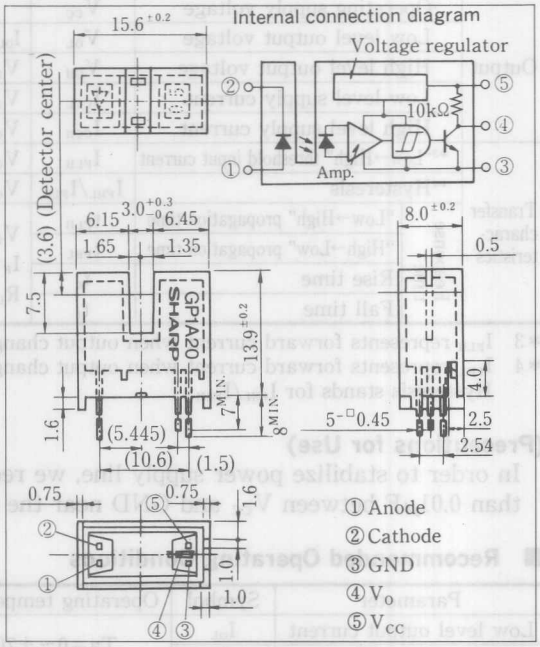
■ Features

1. With cover case
2. High sensing accuracy (Slit width : 0.5mm)
3. Operating supply voltage V_{CC} : 4.5~17V
4. PWB mounting type package

■ Applications

1. Printers
2. Ticket vending machines

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

7

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
Operating temperature		T_{opr}	−25~+85	°C
Storage temperature		T_{stg}	−40~+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=10mA	—	1.1	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17	V
	Low level output voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=0	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=10mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	2.5	5.0	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=10mA	—	1.0	3.0	mA
Transfer characteristics	*3"Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	2.0	9.5	mA
	*4Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V	0.55	0.75	0.95	
	Response time	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=10mA, R_L=280Ω	—	3	9	μs
		"High→Low" propagation time	t_{PHL}		—	5	15	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output changes from low to high.
*4 I_{FHL} represents forward current when output changes from high to low.
Hysteresis stands for I_{FHL}/I_{FLH}.

(Precautions for Use)

In order to stabilize power supply line, we recommend to connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temperature	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0~+70°C	—	16	mA
Forward current	I_F		10	20	mA

Fig. 1 Forward Current vs. Ambient Temperature

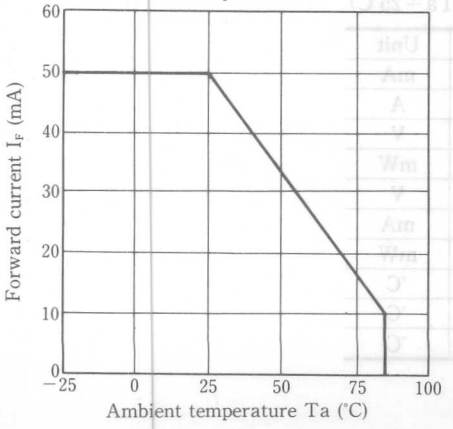


Fig. 2 Output Power Dissipation vs. Ambient Temperature

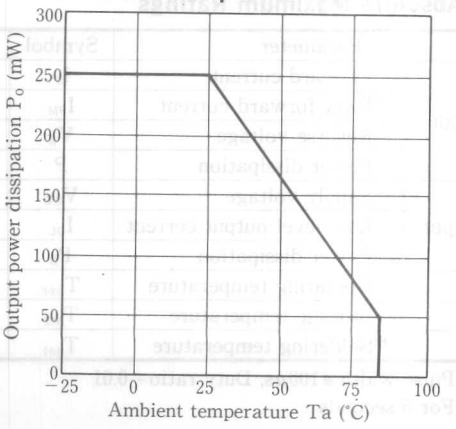


Fig. 3 Low Level Output Current vs. Ambient Temperature

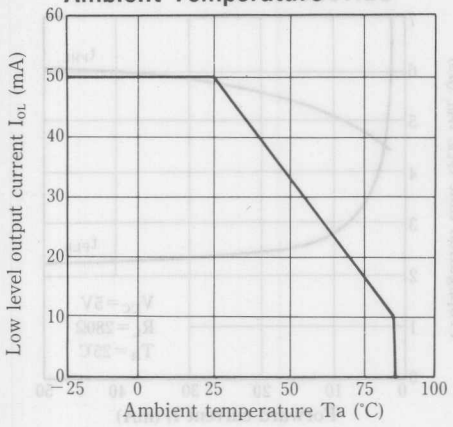


Fig. 4 Forward Current vs. Forward Voltage

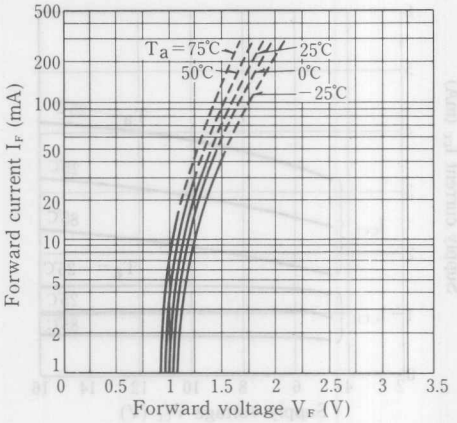


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

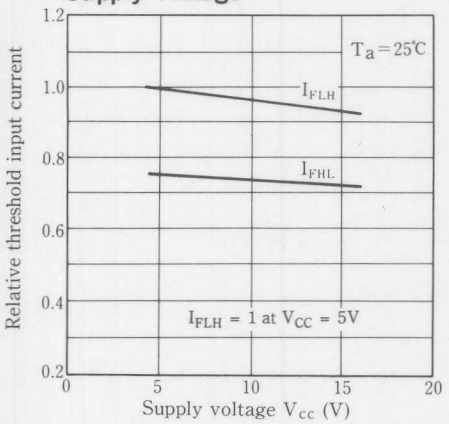


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

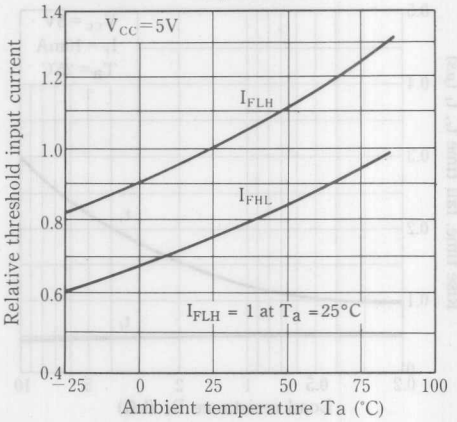


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

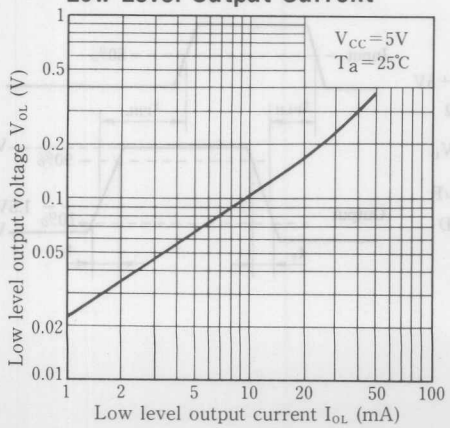
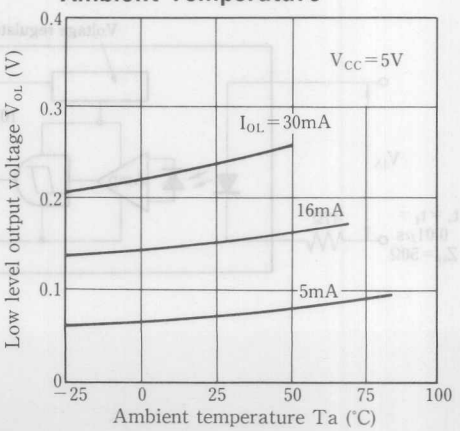


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



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Fig. 9 Supply Current vs. Supply Voltage

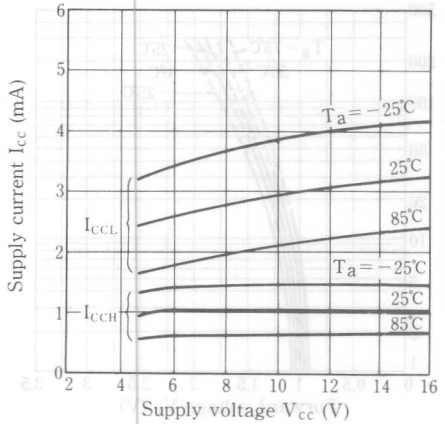


Fig. 10 Propagation Time vs. Forward Current

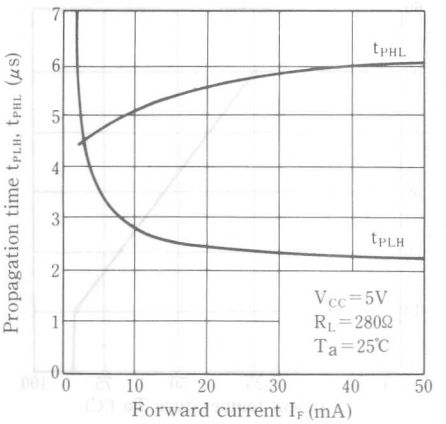
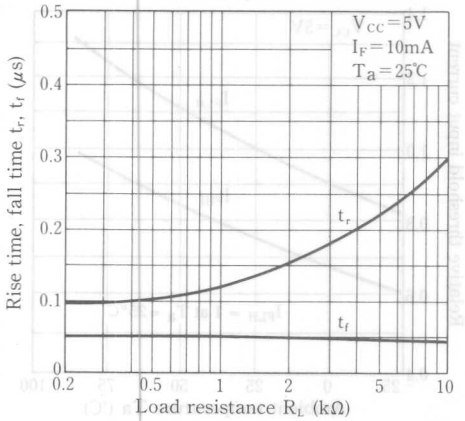
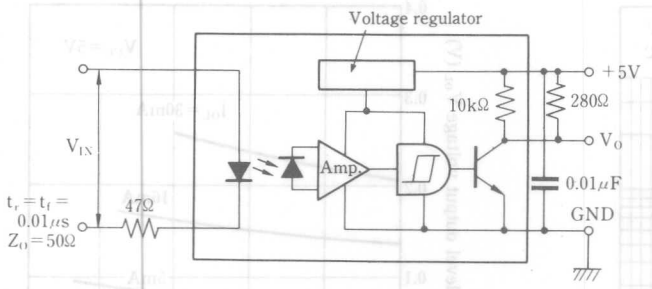
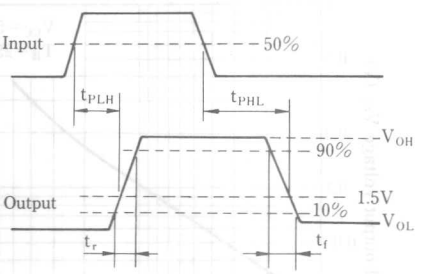


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time





GP1A21/GP1A27LC OPIC Photointerrupter with Connector

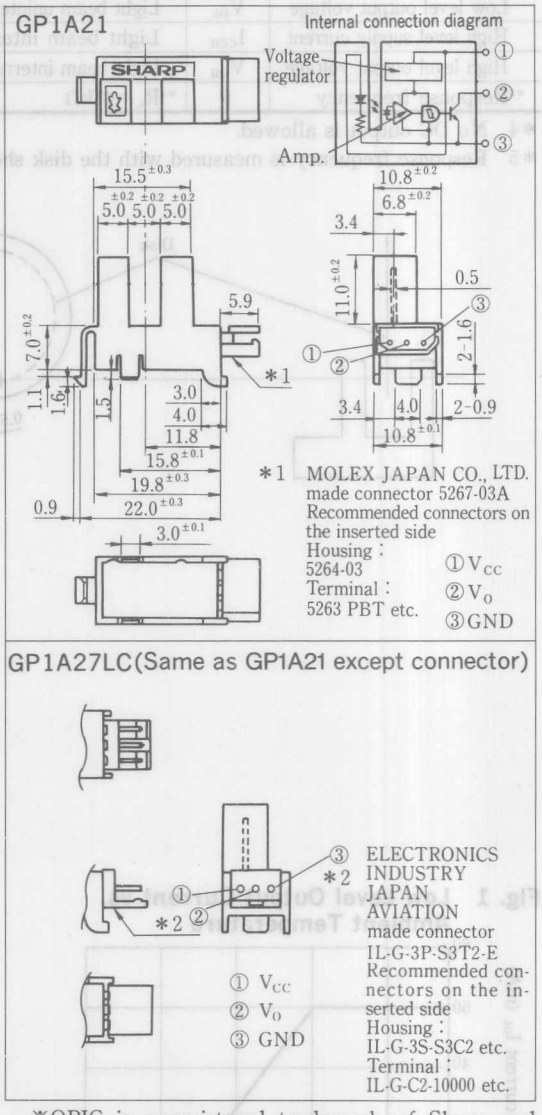
■ Features

1. Snap-in mounting type
2. Uses 3-pin connector terminal
3. High sensing accuracy (Slit width : 0.5mm)
4. Wide gap between light emitter and detector (5mm)

■ Applications

1. Copiers
2. Printers
3. Facsimiles

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	7	V
*1Output voltage	V_O	28	V
*2Low level output current	I_{OL}	50	mA
*3Operating temperature	T_{opr}	−20～+75	°C
*3Storage temperature	T_{stg}	−30～+85	°C

*1 Collector-emitter voltage of output transistor
*2 Collector current of output transistor
*3 The connector should be plugged in/out and the unit's hook should be used at normal temperature.

※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

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■ Electro-optical Characteristics

(Unless otherwise specified, V_{CC}=5V, Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage	V_{CC}		4.5	—	5.5	V
Low level supply current	I_{CCL}	Light beam uninterrupted	—	—	30	mA
Low level output voltage	V_{OL}	Light beam uninterrupted, I_{OL}=16mA	—	—	0.35	V
High level supply current	I_{CCH}	Light beam interrupted	—	—	30	mA
High level output voltage	V_{OH}	Light beam interrupted, R_L=47kΩ	V_{CC}×0.9	—	—	V
*5Response frequency	f	*4R_L=47kΩ	—	—	3,000	Hz

*4 No DC output is allowed.

*5 Response frequency is measured with the disk shown below being rotated. (Unit : mm)

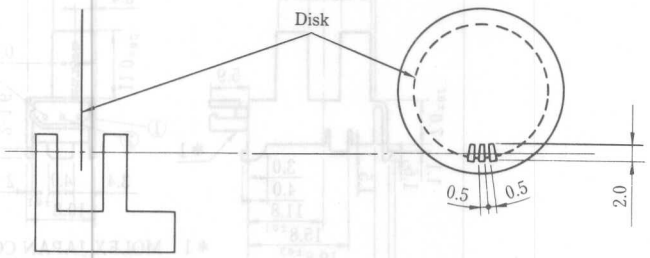


Fig. 1 Low Level Output Current vs. Ambient Temperature

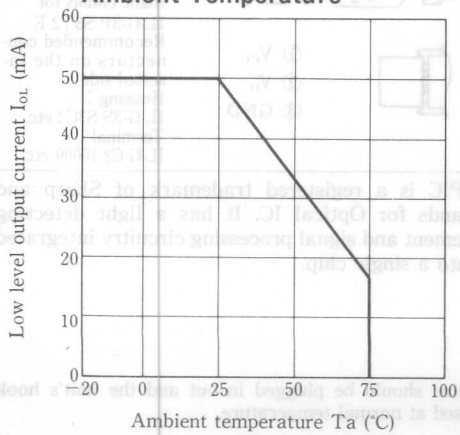


Fig. 2 Low Level Output Voltage vs. Low Level Output Current

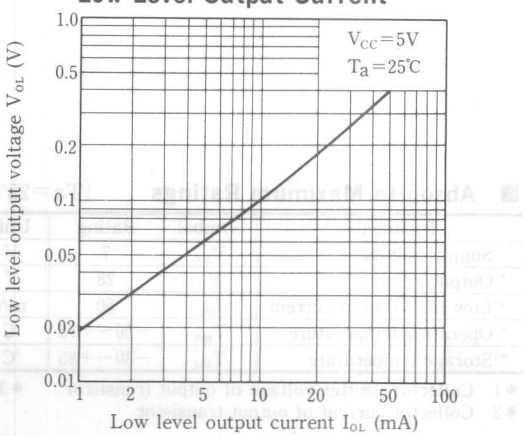


Fig. 3 Low Level Output Voltage vs. Ambient Temperature

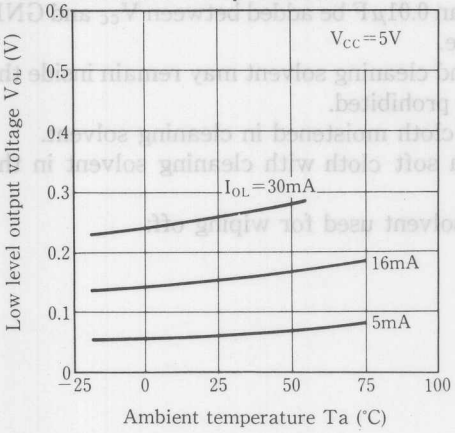


Fig. 4 Supply Current vs. Supply Voltage

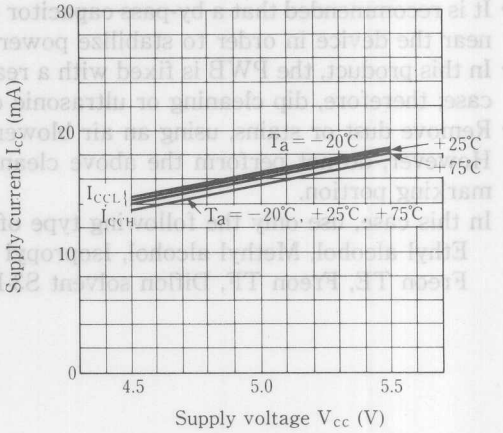


Fig. 5 Detecting Position Characteristics (1)

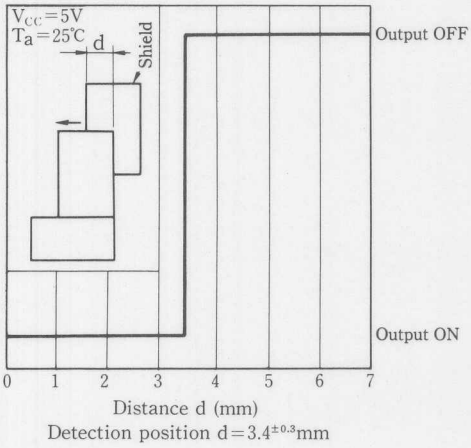
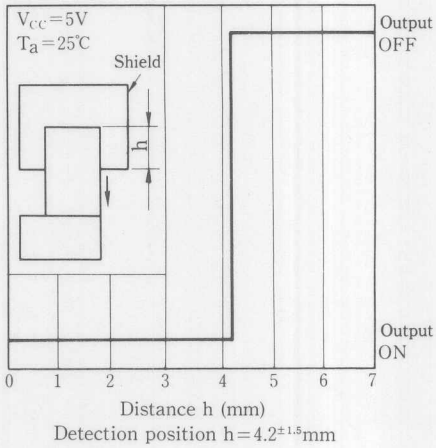
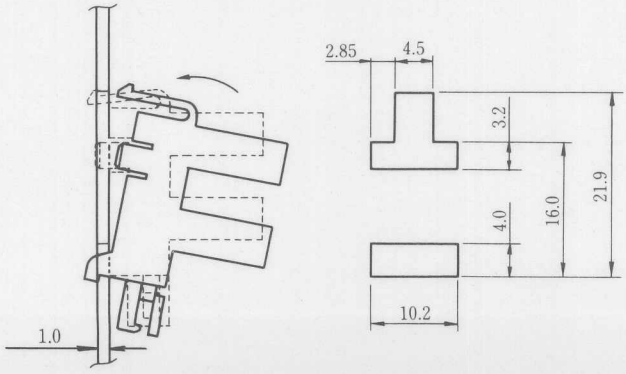


Fig. 6 Detecting Position Characteristics (2)



■ Recommended Mounting Holes



Mounting method (Unit: mm)

Recommended mounting holes (Unit : mm)

7

■ Precautions for Use

- It is recommended that a by-pass capacitor of more than 0.01μF be added between V_{CC} and GND near the device in order to stabilize power supply line.
- In this product, the PWB is fixed with a rear cover, and cleaning solvent may remain inside the case; therefore, dip cleaning or ultrasonic cleaning is prohibited.
- Remove dust or stains, using an air blower or a soft cloth moistened in cleaning solvent. However, do not perform the above cleaning using a soft cloth with cleaning solvent in the marking portion.

  In this case, use only the following type of cleaning solvent used for wiping off:

  Ethyl alcohol, Methyl alcohol, Isopropyl alcohol,
  Freon TE, Freon TF, Diflon solvent S3-E

GP1A30R OPIC Photointerrupter with Encoder Function

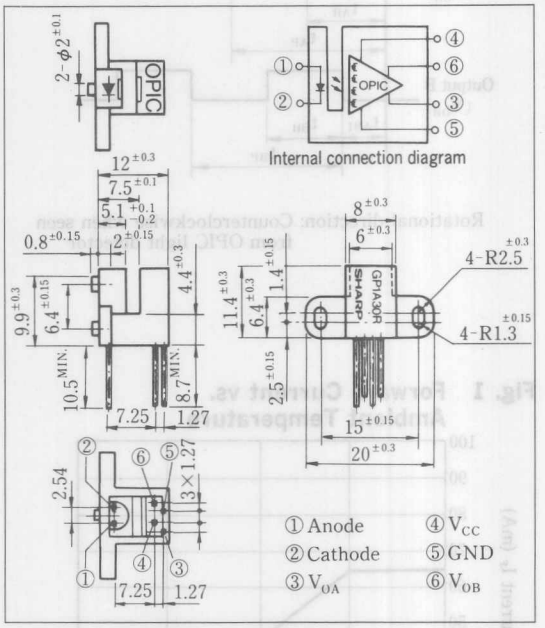
■ Features

1. 2-phase (A, B) digital output
2. Possible to use plastic disk
3. High sensing accuracy
   (Disk slit pitch: 0.7mm)
4. TTL compatible output

■ Applications

1. Electronic typewriters, printers
2. Robots
3. Numerical control machines

■ Outline Dimensions (Unit:mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	65	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	100	mW
Output	Supply voltage	V_{CC}	7	V
	Low level output current	I_{OL}	20	mA
	Power dissipation	P_O	250	mW
	Operating temperature	T_{opr}	0～+70	°C
	Storage temperature	T_{stg}	−40～+80	°C
	*2 Soldering temperature	T_{sol}	260	°C

*1 Pulse width ≦ 100μs, Duty ratio=0.01 *2 For 5 seconds

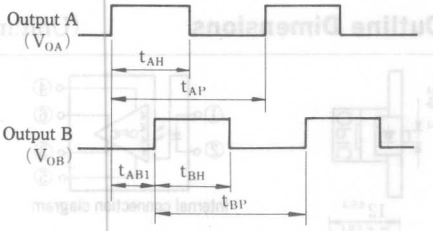
■ Electro-optical Characteristics (Unless otherwise specified, Ta=0～+70°C)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	Ta=25°C, I_F=30mA	—	1.2	1.5	V
	Reverse current	I_R	Ta=25°C, V_R=3V	—	—	10	μA
Output	Operating supply voltage	V_{CC}		4.5	5.0	5.5	V
	High level output voltage	V_{OH}	V_{CC}=5V, I_F=30mA*3	2.4	4.9	—	V
	Low level output voltage	V_{OL}	I_{OL}=8mA, V_{CC}=5V, I_F=30mA*3	—	0.1	0.4	V
	Supply current	I_{CC}	I_F=30mA, V_{CC}=5V*4	—	5	20	mA
Transfer characteristics	Duty ratio	D_A*5	V_{CC}=5V, I_F=30mA, f=2.5kHz*3	0.20	0.50	0.80	—
		D_B*5		0.20	0.50	0.80	—
	Response frequency	$f_{MAX.}$	V_{CC}=5V, I_F=30mA*3	—	—	5	kHz

*3 Measured under the condition shown in Measurement Conditions.
*4 In the condition that output A and B are low level.
*5 $D_A=\frac{t_{AH}}{t_{AP}}$, $D_B=\frac{t_{BH}}{t_{BP}}$

7

■ Output Waveforms



Rotational direction: Counterclockwise when seen from OPIC light detector

Fig. 1 Forward Current vs. Ambient Temperature

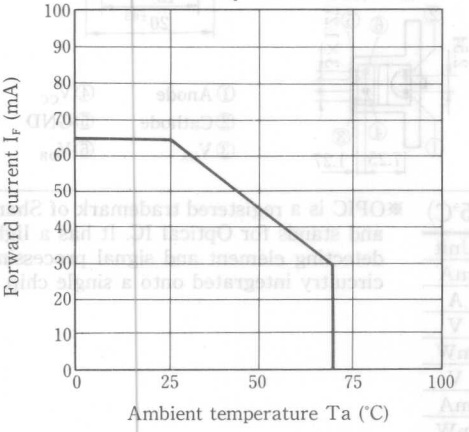


Fig. 2 Output Power Dissipation vs. Ambient Temperature

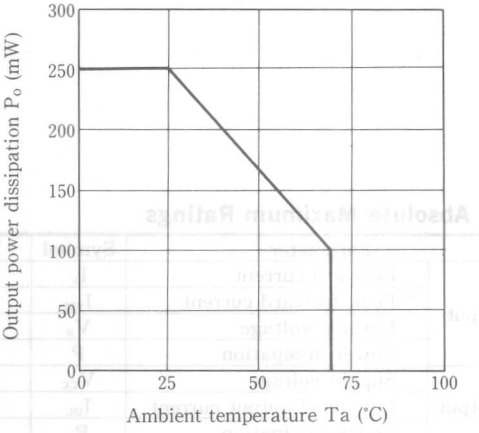


Fig. 3 Duty Ratio vs. Frequency

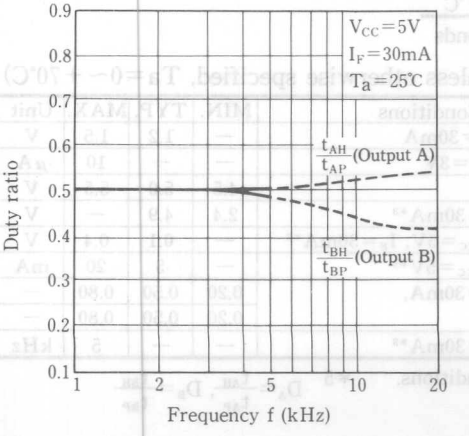


Fig. 4 Phase Difference vs. Frequency

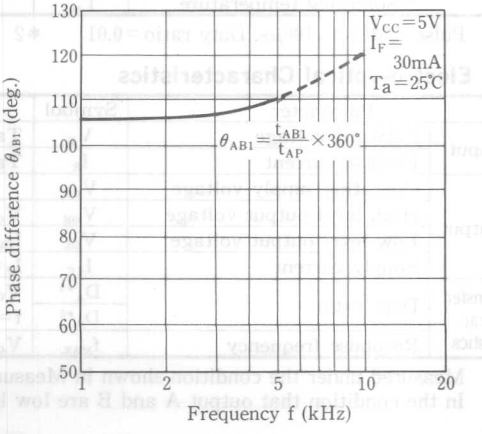


Fig. 5 Duty Ratio vs. Ambient Temperature

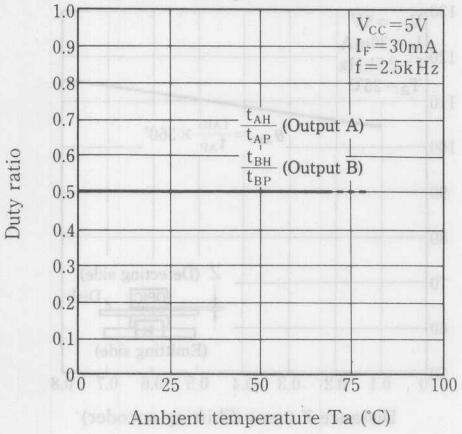


Fig. 6 Phase Difference vs. Ambient Temperature

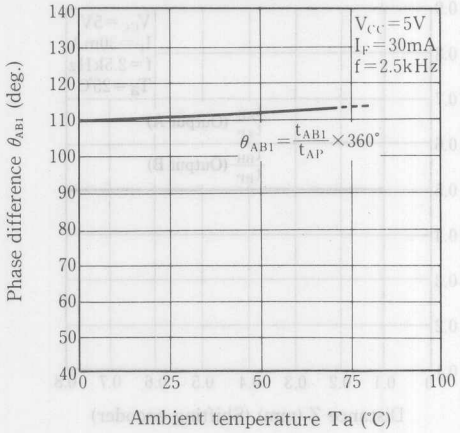


Fig. 7 Duty Ratio vs. Distance (X direction)

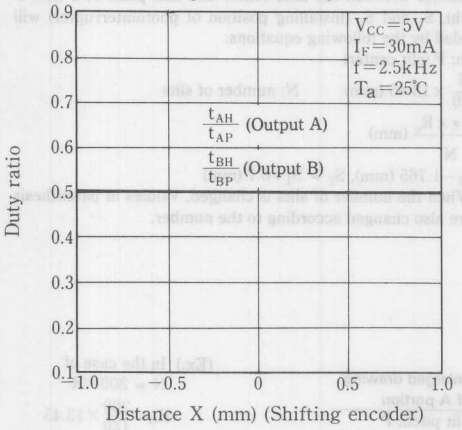


Fig. 8 Phase Difference vs. Distance (X direction)

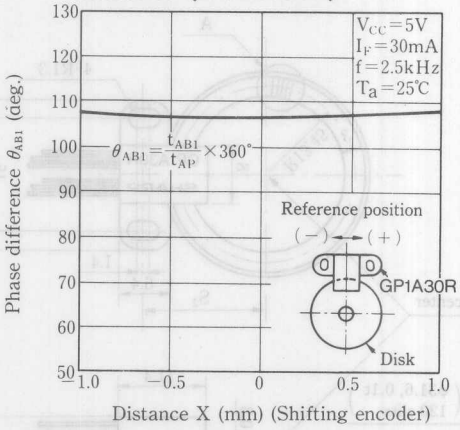


Fig. 9 Duty Ratio vs. Distance (Y direction)

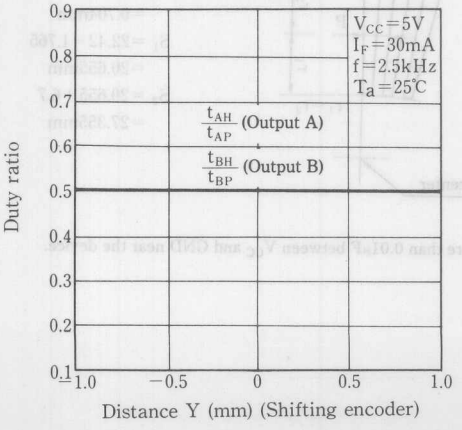
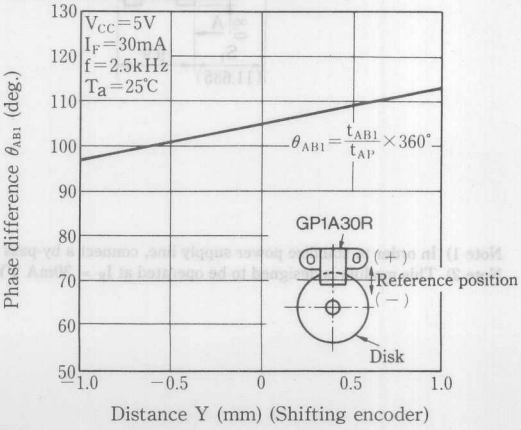


Fig. 10 Phase Difference vs. Distance (Y direction)



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Fig. 11 Duty Ratio vs. Distance (Z direction)

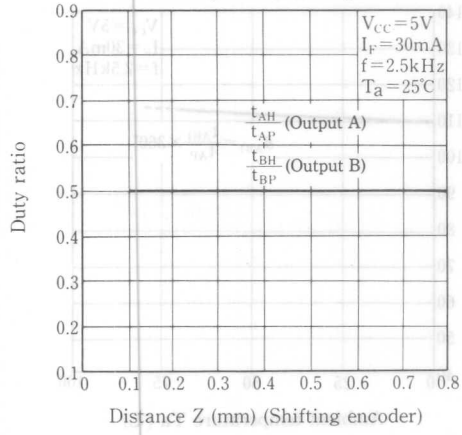
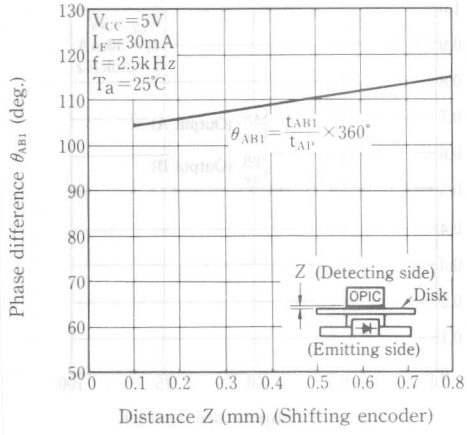
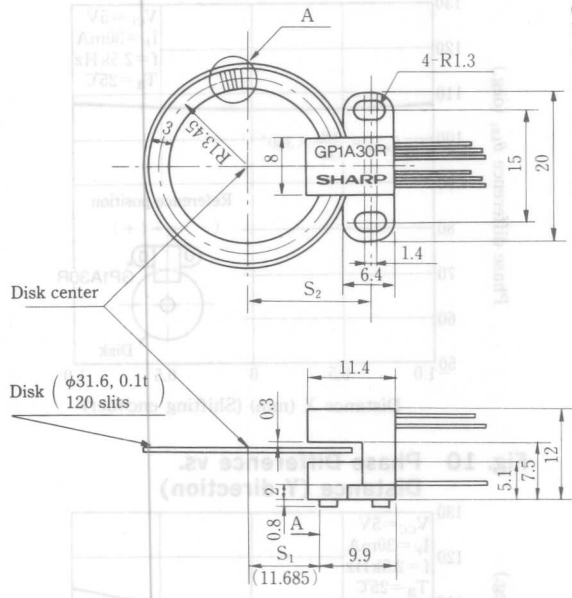


Fig. 12 Phase Difference vs. Distance (Z direction)



■ Measurement Coditions



<Basic Design>

R_o (distance between the disk center and half point of a slit), P (slit pitch), S_1 and S_2 (installing position of photointerrupter) will be provided by the following equations.

Slit pitch: P (slit center)

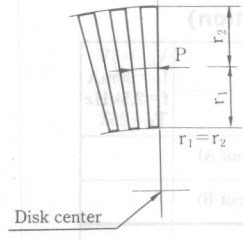
$$R_o = \frac{N}{120} \times 13.45 \text{ (mm)} \qquad N: \text{number of slits}$$

$$P = \frac{2 \times \pi \times R_o}{N} \text{ (mm)}$$

$S_1 = R_O - 1.765$ (mm), $S_2 = S_1 + 6.7$ (mm)

Note) When the number of slits is changed, valules in parenthesis are also changed according to the number.

Enlarged drawing of A portion
Slit pitch: P



(Ex.) In the case of N = 200P/R

$R_O = \frac{200}{120} \times 13.45$

$= 22.42$mm

$P = \frac{2 \times \pi \times 22.42}{200}$

$= 0.704$mm

$S_1 = 22.42 - 1.765$

$= 20.655$mm

$S_2 = 20.655 + 6.7$

$= 27.355$mm

Note 1) In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.
Note 2) This module is designed to be operated at I_F = 30mA TYP.

GP1A31LC OPIC Photointerrupter with Connector

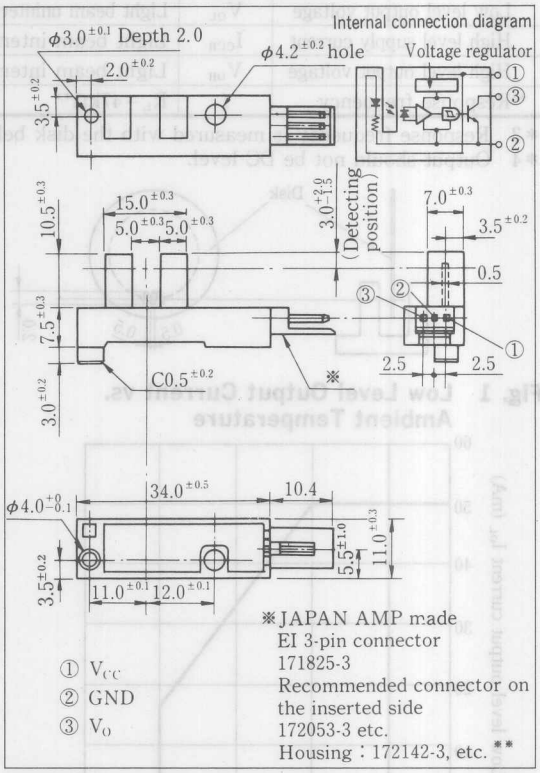
■ Features

1. Uses 3-pin connector terminal
2. Operating supply voltage V_{CC} : 13.5~16.5V
3. High sensing accuracy (Slit width : 0.5mm)
4. Wide gap between light emitter and detector (5mm)

■ Applications

1. Copiers
2. Printers
3. Facsimiles

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

※※Recommended connectors on the inserted side are shown on the page after next.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	−0.5~+18	V
*1Output voltage	V_O	−0.5~+28	V
*2Low level output current	I_{OL}	50	mA
*3Operating temperature	T_{opr}	−20~+75	°C
*3Storage temperature	T_{stg}	−40~+85	°C

*1 Collector-emitter voltage of output transistor
*2 Collector current of output transistor
*3 The connector should be plugged in/out at normal temperature.

7

■ Electro-optical Characteristics

(V_{CC}=15V±10%, Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage	V_{CC}		13.5	—	16.5	V
Low level supply current	I_{CCL}	Light beam uninterrupted	—	—	30	mA
Low level output voltage	V_{OL}	Light beam uninterrupted, I_{OL}=16mA	—	—	0.35	V
High level supply current	I_{CCH}	Light beam interrupted	—	—	30	mA
High level output voltage	V_{OH}	Light beam interrupted, R_L=47kΩ	V_{CC}×0.9	—	—	V
*3Response frequency	f	R_L=47kΩ*4	—	—	3,000	Hz

*3 Response frequency is measured with the disk below being rotated. (Unit : mm)
*4 Output should not be DC level.

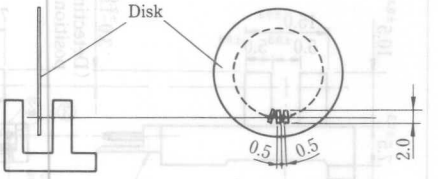


Fig. 1 Low Level Output Current vs. Ambient Temperature

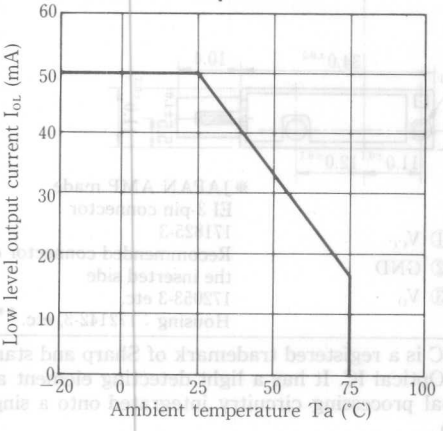


Fig. 2 Low Level Output Voltage vs. Low Level Output Current

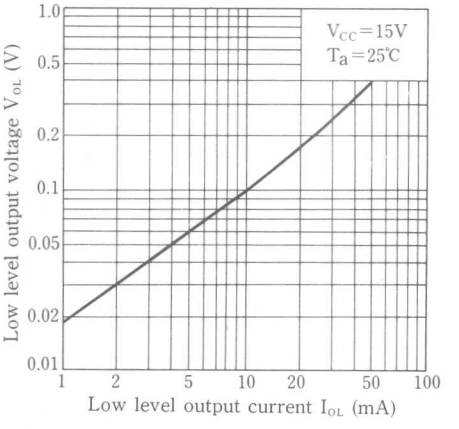


Fig.3 Low Level Output Voltage vs. Ambient Temperature

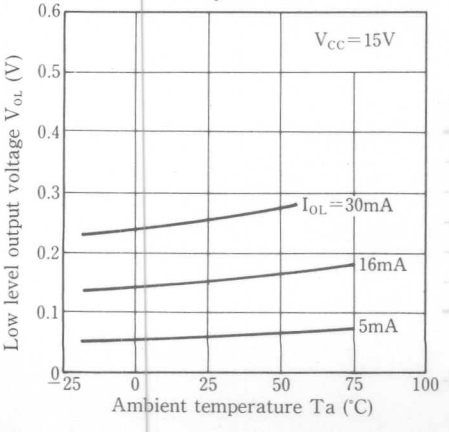


Fig. 4 Supply Current vs. Supply Voltage

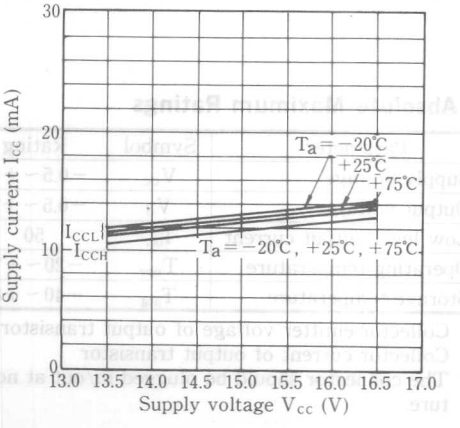
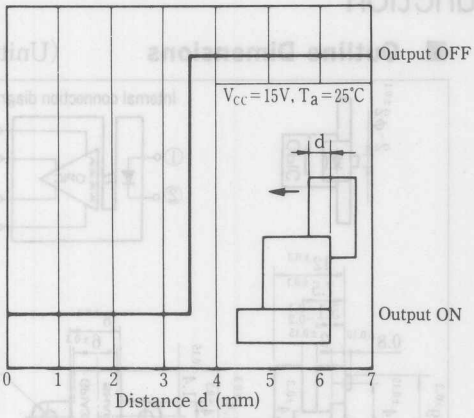
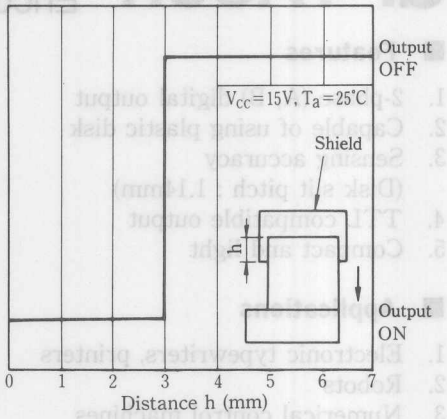


Fig. 5 Detecting Position Characteristics (1)



Detecting position $d=3.5^{\pm 0.3}$mm

Fig. 6 Detecting Position Characteristics (2)



Detecting position $h=3.0^{+2.0}_{-1.5}$ mm

■ Recommended Connectors

● JAPAN AMP made EI series connectors (standard type)

Housing color	Natural color	Black	Blue	Green	Red
Housing Model No.	171822-3	2-171822-3	4-171822-3	6-171822-3	8-171822-3

	AWG size	Product shape	Material	Model No.
Special terminal Model No.	AWG 26~20	Bulk	Brass	170204-1
			Copper phosphide	170204-2
		Chain	Brass	170262-1
			Copper phosphide	170262-2
	AWG 30~26	Bulk	Brass	170205-1
			Copper phosphide	170205-2
		Chain	Brass	170263-1
			Copper phosphide	170263-2

● JAPAN AMP made EI series connectors (low profile type)

Housing color	Natural color	Black	Blue	Green	Red
Housing Model No.	172142-3	2-172142-3	4-172142-3	6-172142-3	8-172142-3

	AWG Size	Product shape	Model No.
Special terminal Model No. (Material : Copper phosphide)	AWG 26~22	Bulk	170369-1
		Chain	170354-1
	AWG 30~26	Bulk	170370-1
		Chain	170355-1

● JAPAN AMP made EI series connectors (amp mass termination)

Housing-terminal unit type connector	AWB28 (Green)	AWG26 (Natural color)	AWG24 (Black)	AWG22 (Red)
	172054-3	172053-3	172052-3	172051-3

※ Terminal material : Copper phosphide

■ Precautions for Use

- It is recommended that a by-pass capacitor of more than 0.01μF be added between V_{CC} and GND near the device in order to stabilize power supply line.
- In this product, the PWB is fixed with a rear cover, and cleaning solvent may remain inside the case; therefore, dip cleaning or ultrasonic cleaning is prohibited.
- Remove dust or stains, using an air blower or a soft cloth moistened in cleaning solvent. However, do not perform the above cleaning using a soft colth with cleaning solvent in the marking portion.

  In this case, use only the following type of cleaning solvent used for wiping off:
  Ethyl alcohol, Methyl alcohol, Isopropyl alcohol,
  Freon TE, Freon TF, Diflon solvent S3-E

7

GP1A33R OPIC Photointerrupter with Encoder Function

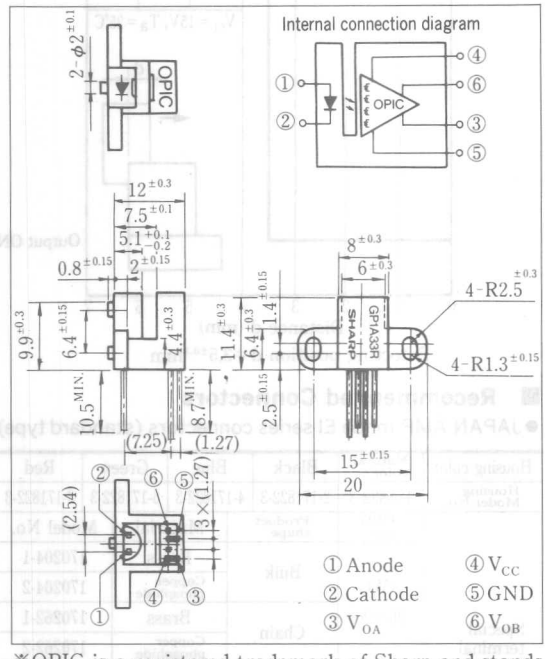
■ Features

1. 2-phase (A, B) digital output
2. Capable of using plastic disk
3. Sensing accuracy
   (Disk slit pitch : 1.14mm)
4. TTL compatible output
5. Compact and light

■ Applications

1. Electronic typewriters, printers
2. Robots
3. Numerical control machines

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	65	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	100	mW
Output	Supply voltage	V_{CC}	7	V
	Low level output current	I_{OL}	20	mA
	Power dissipation	P_O	250	mW
Operating temperature		T_{opr}	0～+70	°C
Storage temperature		T_{stg}	−40～+80	°C
*2 Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Unless otherwise specified, Ta=0~+70°C)

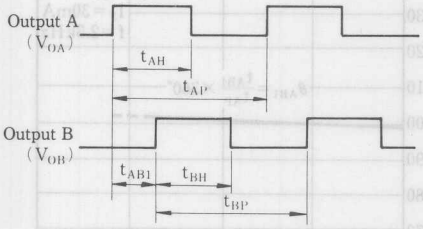
Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	Ta=25°C, I_F=300mA	—	1.2	1.5	V
	Reverse current	I_R	Ta=25°C, V_R=3V	—	—	10	μA
Output	Operating supply voltage	V_{CC}		4.5	5.0	5.5	V
	High level output voltage	V_{OH}	V_{CC}=5V, I_F=30mA*3	2.4	4.9	—	V
	Low level output voltage	V_{OL}	I_{OL}=8mA, V_{CC}=5V, I_F=30mA*3	—	0.1	0.4	V
	Supply current	I_{CC}	I_F=30mA, V_{CC}=5V*4	—	5	20	mA
Transfer characteristics	Duty ratio	D_A*5	V_{CC}=5V, I_F=30mA,	0.20	0.50	0.80	—
		D_B*5	f=2.5kHz*3	0.20	0.50	0.80	—
	Response frequency	$f_{MAX.}$	V_{CC}=5V, I_F=30mA*3	—	—	5	kHz

*3 Measured under the condition shown in Measurement Conditions.

*4 In the condition that output A and B are low level.

*5 $D_A=\frac{t_{AH}}{t_{AP}}$, $D_B=\frac{t_{BH}}{t_{BP}}$

■ Output Waveforms



Rotational direction: Counterclockwise when seen from OPIC light detector

Fig. 1 Forward Current vs. Ambient Temperature

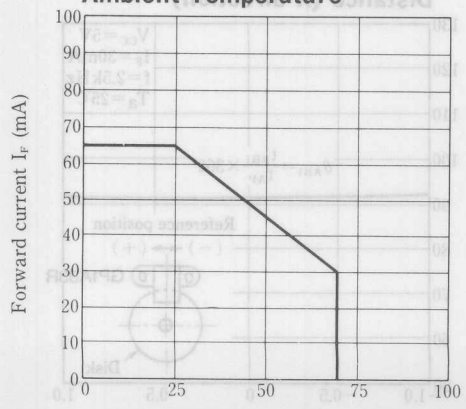
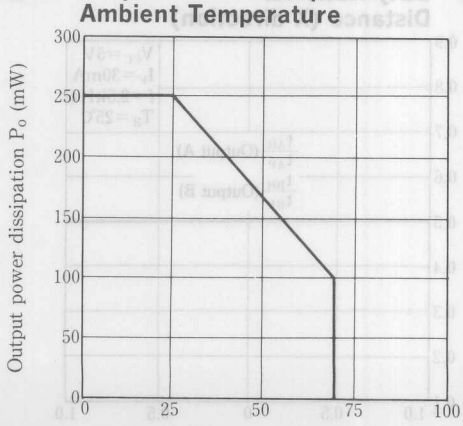


Fig. 2 Output Power Dissipation vs. Ambient Temperature



7

Fig. 3 Duty Ratio vs. Frequency

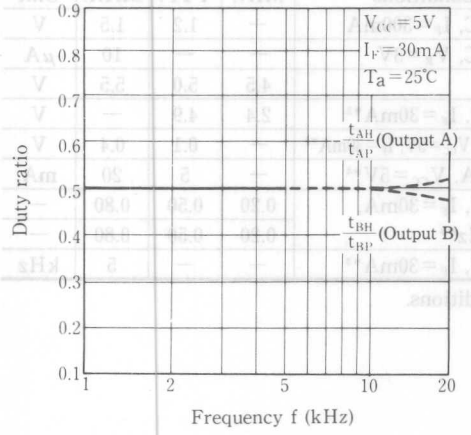


Fig. 4 Phase Difference vs. Frequency

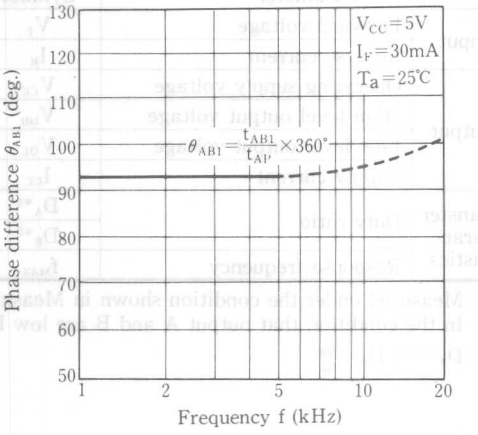


Fig. 5 Duty Ratio vs. Ambient Temperature

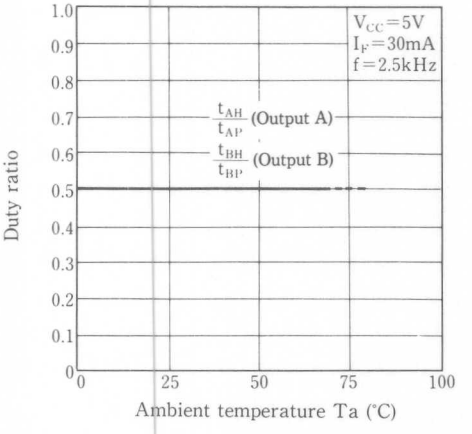


Fig. 6 Phase Difference vs. Ambient Temperature

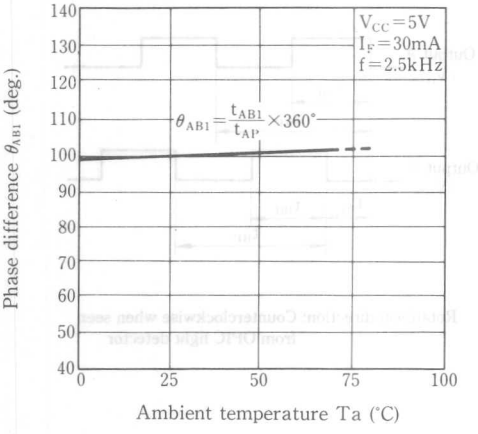


Fig. 7 Duty Ratio vs. Distance (X direction)

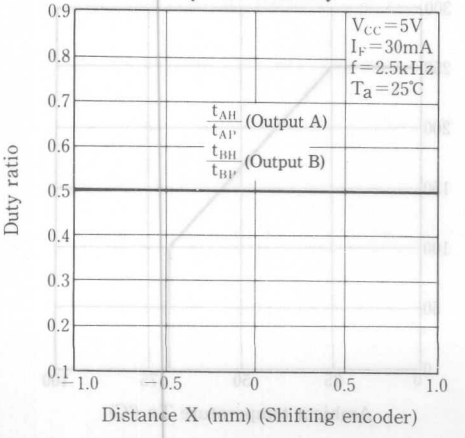


Fig. 8 Phase Difference vs. Distance (X direction)

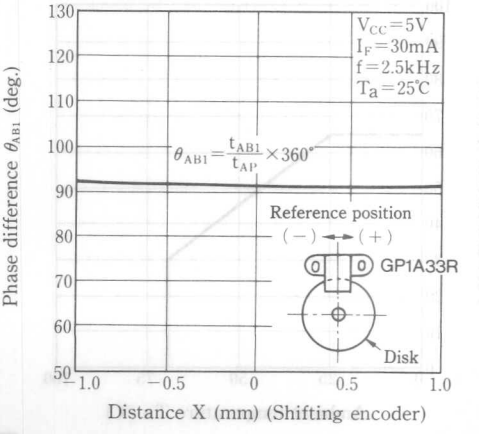


Fig. 9 Duty Ratio vs. Distance (Y direction)

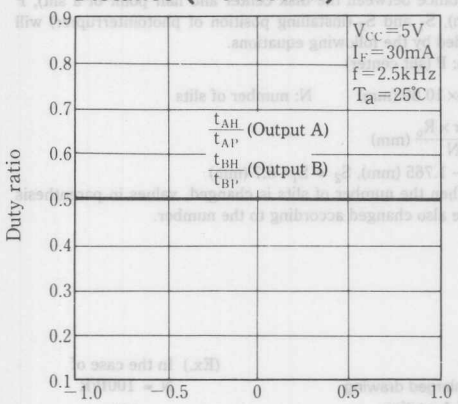


Fig. 10 Phase Difference vs. Distance (Y direction)

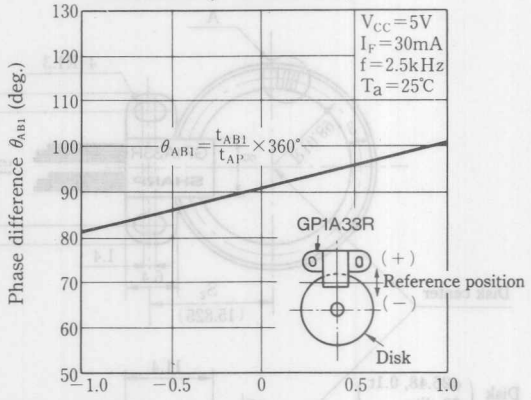


Fig. 11 Duty Ratio vs. Distance (Z direction)

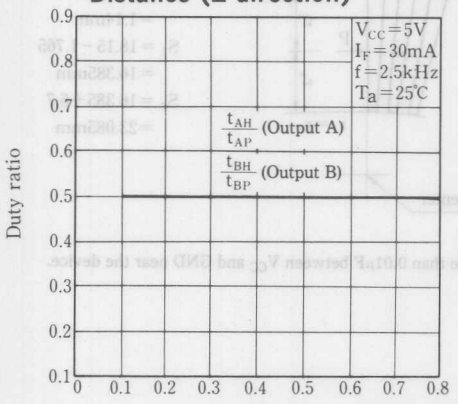
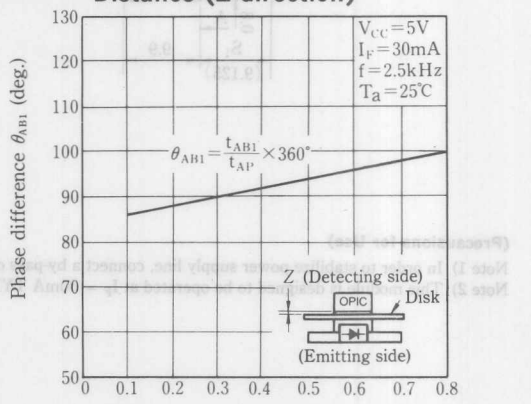
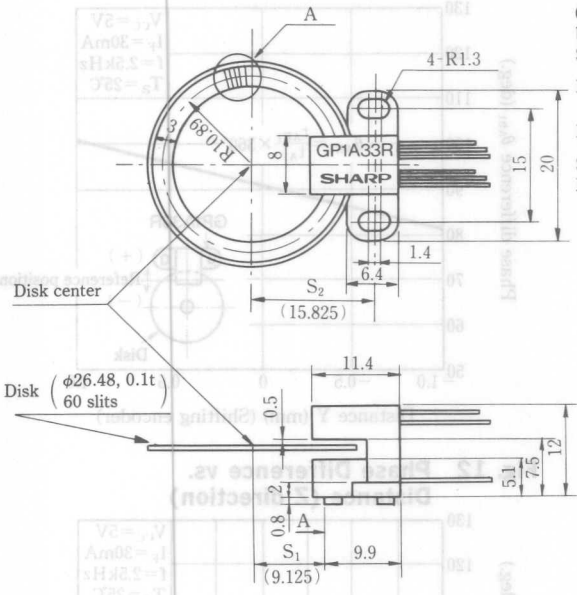


Fig. 12 Phase Difference vs. Distance (Z direction)



7

〈Measurement conditions〉



<Basic Design>

R_o (distance between the disk center and half point of a slit), P (slit pitch), S_1 and S_2 (installing position of photointerrupter) will be provided by the following equations.

Slit pitch: P (slit center)

$$R_o = \frac{N}{60} \times 10.89 \text{ (mm)} \qquad N: \text{number of slits}$$

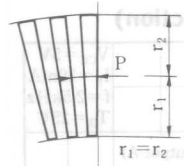
$$P = \frac{2 \times \pi \times R_o}{N} \text{ (mm)}$$

$S_1 = R_0 - 1.765$ (mm), $S_2 = S_1 + 6.7$ (mm)

Note) When the number of slits is changed, values in parenthesis are also changed according to the number.

Enlarged drawing of A portion

Slit pitch: P details



Disk center

(Ex.) In the case of N = 100P/R

$$R_O = \frac{100}{60} \times 10.89 = 18.15\text{mm}$$

$$P = \frac{2 \times \pi \times 18.15}{100} = 1.14\text{mm}$$

$$S_1 = 18.15 - 1.765 = 16.385\text{mm}$$

$$S_2 = 16.385 + 6.7 = 23.085\text{mm}$$

(Precausions for Use)

Note 1) In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

Note 2) This module is designed to be operated at I_F = 30mA TYP.

GP1A34LC OPIC Photointerrupter with Connector

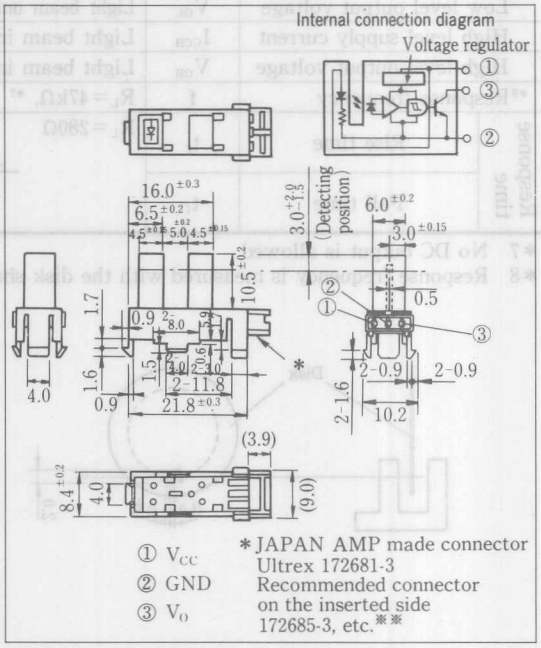
■ Features

1. Snap-in mounting type
2. Can be mounted on 2 different thickness boards (1.0mm, 1.6mm).
3. Uses 3-pin connector terminal
4. High sensing accuracy (Slit width: 0.5mm)
5. Wide gap between light emitter and detector (5mm)

■ Applications

1. Copiers, Printers, facsimiles

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

※※Recommended connectors on the inserted side are shown on the page after next.

7

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	−0.5～+7	V
*1Output voltage	V_O	−0.5～+13	V
*2Low level output current	I_{OL}	10	mA
*3Operating temperature	T_{opr}	−20～+75	°C
*3Storage temperature	T_{stg}	−30～+85	°C

*1 Collector-emitter voltage of output transistor
*2 Collector current of output transistor
*3 The connector should be plugged in/out and the unit's hook should be used at normal temperature.

■ Electro-optical Characteristics

(V_{CC}=5V, T_a=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage		V_{CC}		4.5	—	5.5	V
Low level supply cuurent		I_{CCL}	Light beam uninterrupted	—	—	30	mA
Low level output voltage		V_{OL}	Light beam uninterrupted, I_{OL}=2.5mA	—	—	0.4	V
High level supply current		I_{CCH}	Light beam interrupted	—	—	30	mA
High level output voltage		V_{OH}	Light beam interrupted, R_L=47kΩ	4.5	—	—	V
*8 Response frequency		f	R_L=47kΩ, *7	—	—	3,000	Hz
Response time	Rise time	t_r	R_L=280Ω 	—	0.1	0.5	μs
	Fall time	t_f		—	0.05	0.5	μs

*7 No DC output is allowed.

*8 Response frequency is measured with the disk shown below being rorated. (Unit : mm)

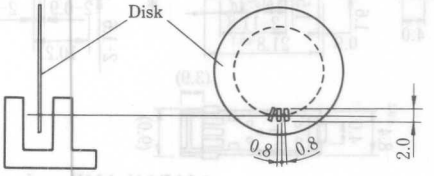


Fig. 1 Low Level Output Current vs. Ambient Temperature

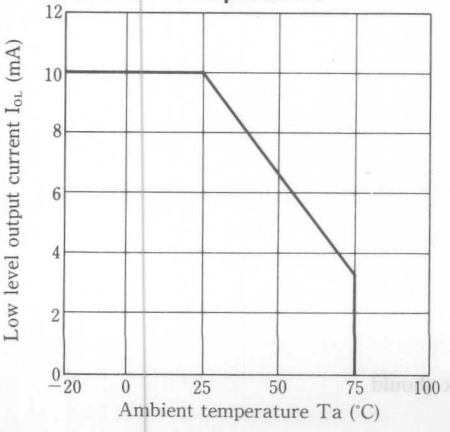


Fig. 2 Low Level Output Voltage vs. Low Level Output Current

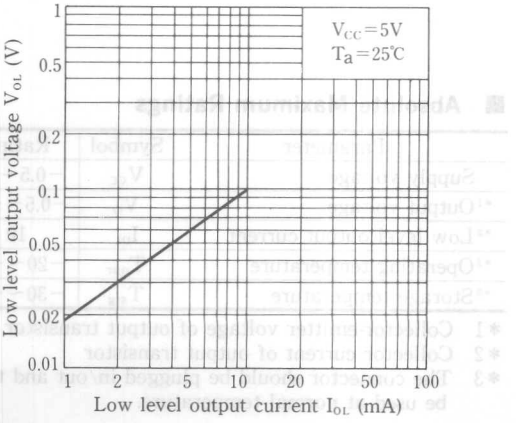


Fig. 3 Low Level Output Voltage vs. Ambient Temperature

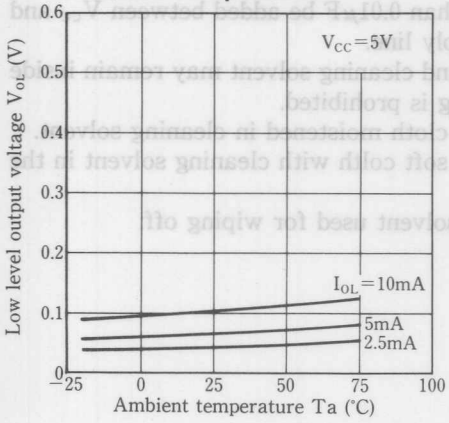


Fig. 4 Supply Current vs. Supply Voltage

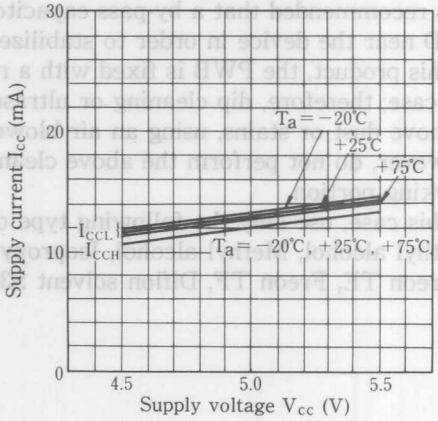
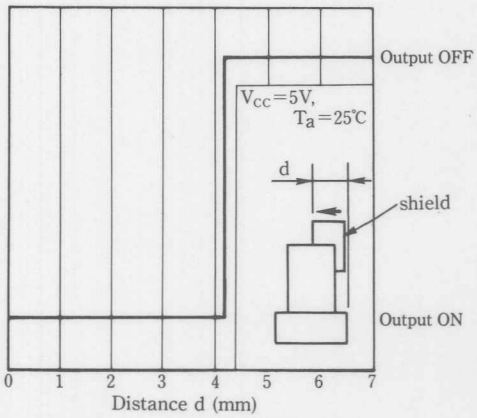
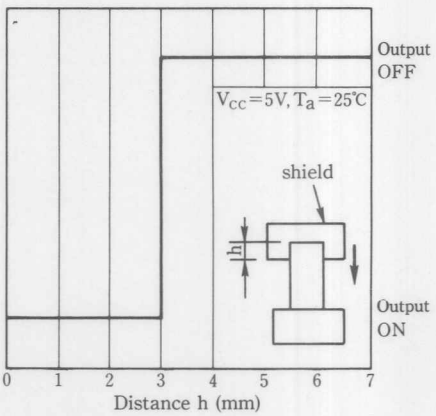


Fig. 5 Detecting Position Characteristics (1)



Detecting position d=$4.2^{\pm 0.3}$mm

Fig. 6 Detecting Position Characteristics (2)



Detecting position h=$3.0^{+2.0}_{-1.5}$mm

■ Recommended Connectors on the Inserted Side

● JAPAN AMP made Ultrex connector (Soldeless type)

Housing Model No.	172677-3			
	AWG size	Product shape	Material	Model No.
Special terminal Model No.	AWG 30~26	Chain	Copper phosphide	171609-1
		Bulk		171611-1
	AWG 26~22	Chain		171610-1
		Bulk		171612-1

● JAPAN AMP made Ultrex collector (mass termination type)

172685-3

■ Recommended Mounting Holes

Same as GP1S09

7

■ Precautions for Use

- It is recommended that a by-pass capacitor of more than 0.01μF be added between V_{CC} and GND near the device in order to stabilize power supply line.
- In this product, the PWB is fixed with a rear cover, and cleaning solvent may remain inside the case; therefore, dip cleaning or ultrasonic cleaning is prohibited.
- Remove dust or stains, using an air blower or a soft cloth moistened in cleaning solvent. However, do not perform the above cleaning using a soft colth with cleaning solvent in the marking portion.

  In this case, use only the following type of cleaning solvent used for wiping off:

  Ethyl alcohol, Methyl alcohol, Isopropyl alcohol,
  Freon TE, Freon TF, Diflon solvent S3-E

GP1A35R OPIC Photointerrupter with Encoder Functions

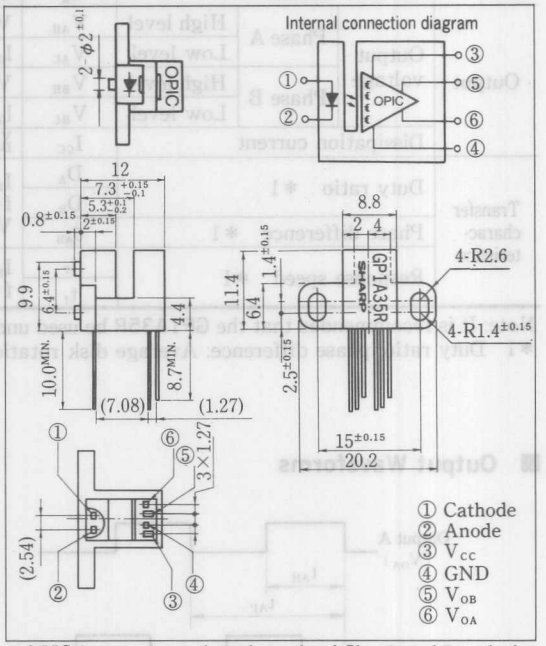
■ Features

1. 2-phase (A, B) digital output
2. High sensing accuracy
   (Disk slit pitch: 0.22mm, Moiré stripe application)
3. TTL compatible output
4. Compact and light

■ Applications

1. Electronic typewriters, printers
2. Robots, X-Y plotter
3. Numerical control machines

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

7

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	65	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	100	mW
Output	Supply voltage	V_{CC}	7	V
	Low level output current	I_{OL}	20	mA
	Power dissipation	P_O	250	mW
	Operating temperature	T_{opr}	0～+70	°C
	Storage temperature	T_{stg}	−40～+80	°C
	*2 Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01 *2 For 5 seconds

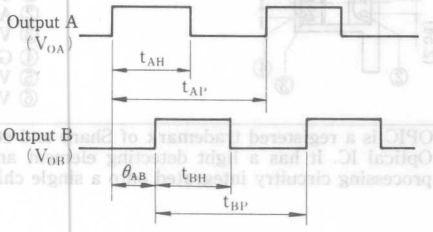
■ Electro-optical Characteristics

(Ta=25°C)

Parameter				Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage			V_F	I_F=30mA	—	1.2	1.5	V
	Reverse current			I_R	V_R=3V	—	—	10	μA
Output	Output voltage	Phase A	High level	V_{AH}	V_{CC}=5V, I_F=30mA	2.4	4.9	—	V
			Low level	V_{AL}	I_{OL}=8mA, I_F=30mA, V_{CC}=5V	—	0.1	0.4	
		Phase B	High level	V_{BH}	V_{CC}=5V, I_F=30mA	2.4	4.9	—	
			Low level	V_{BL}	I_{OL}=8mA, I_F=30mA, V_{CC}=5V	—	0.1	0.4	
	Dissipation current			I_{CC}	V_{CC}=5V, I_F=30mA Both phases A and B at low level	—	—	20	mA
Transfer characteristics	Duty ratio *1			D_A	I_F=30mA f=12kHz V_{CC}=5V	30	50	70	%
				D_B					
	Phase difference *1			θ_{AB}		50	90	130	degree
	Response speed *1			t_r	I_F=30mA, V_{CC}=5V f=12kHz	—	1.0	2.0	μ sec
				t_f		—	1.0	2.0	

Note: It is recommended that the GP1A35R be used under the condition of I_F=30mA Typ. for which it is designed.
*1 Duty ratio, phase difference: Average disk rotation time per turn.

■ Output Waveforms



Rotational direction: Counterclockwise when seen from OPIC light detector

$$D_A=\frac{t_{AH}}{t_{AP}}\times 100$$

$$D_B=\frac{t_{BH}}{t_{BP}}\times 100$$

Fig. 1 Forward Current vs. Ambient Temperature

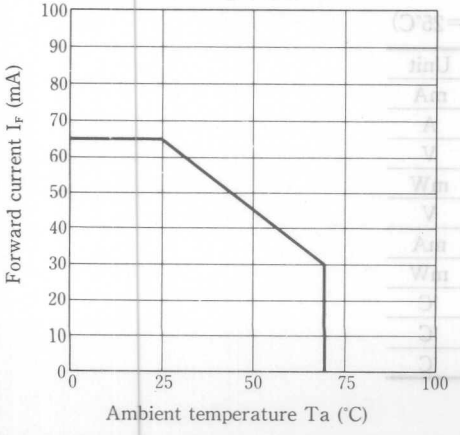


Fig. 2 Output Power Dissipation vs. Ambient Temperature

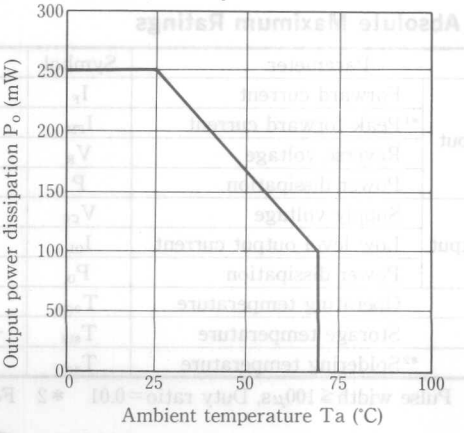


Fig. 3 Duty Ratio vs. Frequency

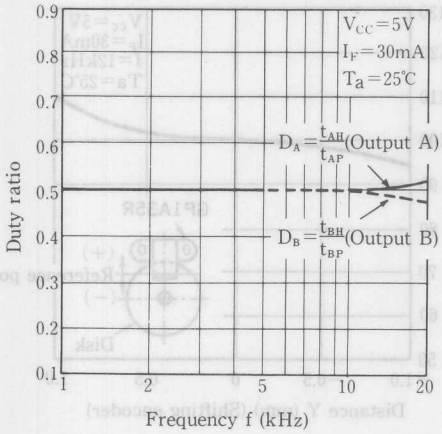


Fig. 4 Phase Difference vs. Frequency

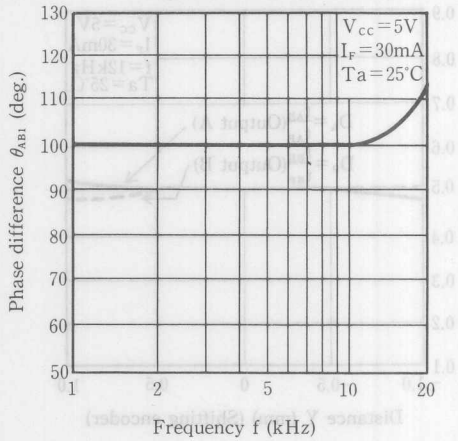


Fig. 5 Duty Ratio vs. Ambient Temperature

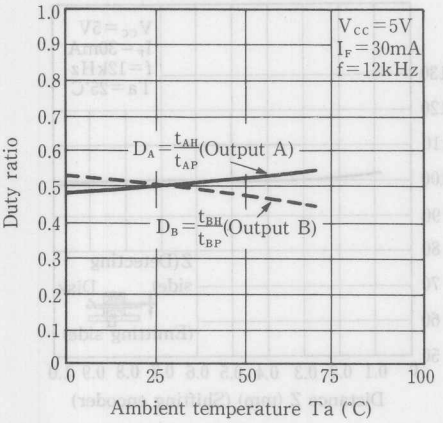


Fig. 6 Phase Difference vs. Ambient Temperature

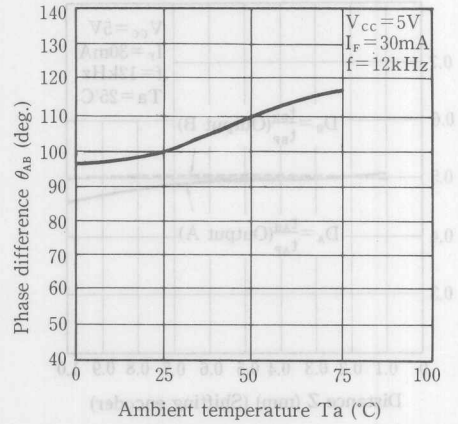


Fig. 7 Duty Ratio vs. Distance (X direction)

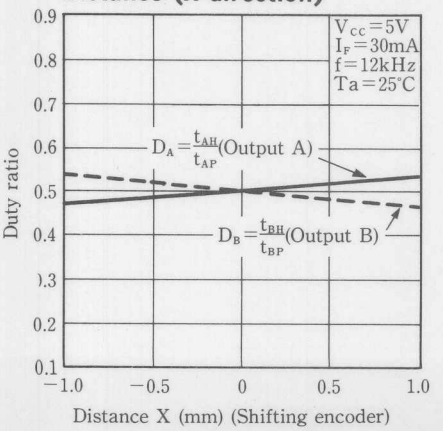
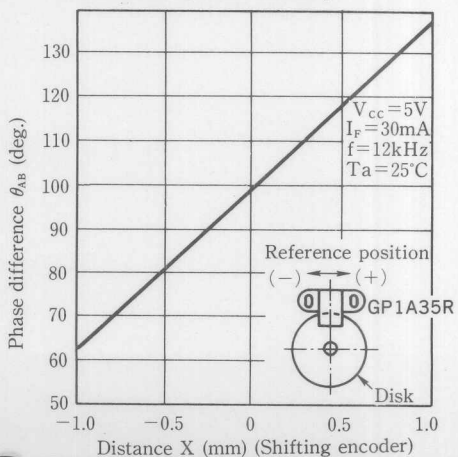


Fig. 8 Phase Difference vs. Distance (X direction)



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Fig. 9 Duty Ratio vs. Distance (Y direction)

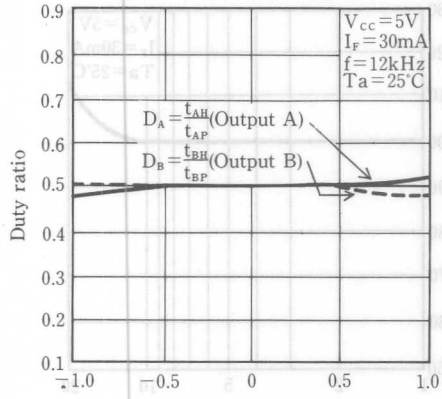


Fig. 10 Phase Difference vs. Distance (Y direction)

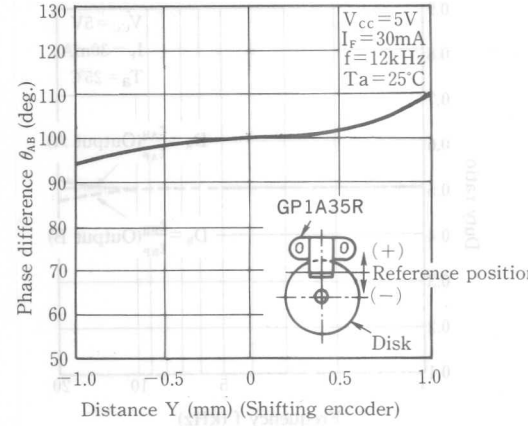


Fig. 11 Duty Ratio vs. Distance (Z direction)

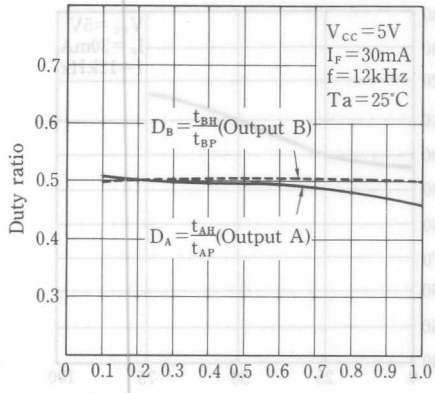
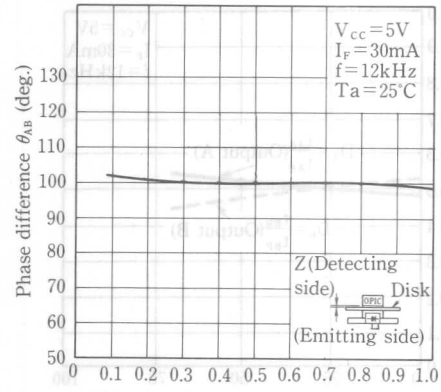
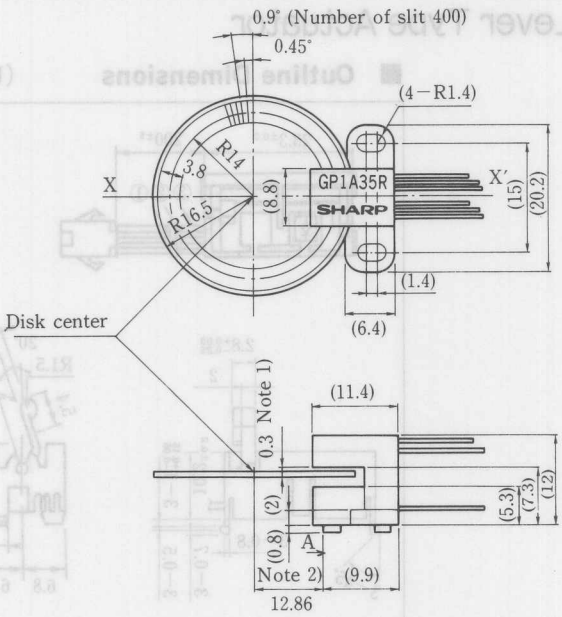


Fig. 12 Phase Difference vs. Distance (Z direction)



<Measurement conditions>



Note 1) Distance between disk surface and case surface in the detector side is 0.3mm.
2) Encoder positioning pin is positioned on X−X′ axis.
Distance between center of disk and portion A of positioning pin is 12.86mm.
3) Center of disk slit is R14.0.

(Precausions for Use)

Note 1) In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

Note 2) This module is designed to be operated at I_F=30mA TYP.

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GP1A40 Connector Terminal Type OPIC Photointerrupter with Lever Type Actuator

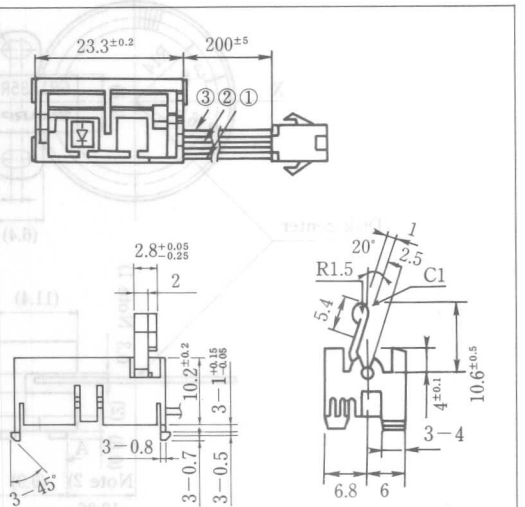
■ Features

1. With lever type actuator
2. Connector terminal type

■ Applications

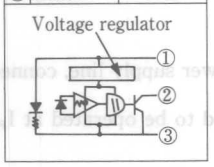
1. Copiers
2. Facsimiles

■ Outline Dimensions (Unit : mm)



Internal connection diagram

No.	Lead color	Terminal
①	Red	V_{CC}
②	Blue	V_O
③	Black	GND



Housing: JAPAN SOLDERLESS TERMINAL MSG. CO., LTD. made SMP-03V-BC
Terminal: JAPAN SOLDERLESS TERMINAL MSG. CO., LTD. made SHF-001T-08BS

※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit	Remark
Supply voltage	V_{CC}	7	V	—
Output voltage	V_{out}	28	V	Collector-emitter voltage of output transistor
Output current	I_O	50	mA	Collector current of output transistor *1
Operating temperature	T_{opr}	−25～+75	°C	The connector should be plugged in/out at normal temperature.
Storage temperature	T_{stg}	−30～+85	°C	The connector should be plugged in/out at normal temperature.

*1 Fig. 1 shows output current derating curve.

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating supply voltage		V_{CC}	—	4.5	—	5.5	V
Low level output voltage		V_{OL}	Light beam uninterrupted, I_{OL}=16mA, V_{CC}=5V	—	—	0.4	V
Low level current dissipation		I_{CCL}	Light beam uninterrupted, V_{CC}=5V	—	—	30	mA
High level output voltage		V_{OH}	Light beam interrupted, R_L=47kΩ, V_{CC}=5V	V_{CC}×0.9	—	—	V
High level current dissipation		I_{CCH}	Light beam interrupted, V_{CC}=5V	—	—	30	mA
Response Characteristics	Minimum shield time	t_H	R_L=280Ω, V_{CC}=5V	166	—	—	μs
	Minimun incident time	t_L	R_L=280Ω, Vcc=5V	166	—	—	μs

■ Mechanical Characteristics

Parameter	Symbol	Requirements
Mounting angle	θ_1	75±3°
Opaque angle *1	θ_2	85° MAX. 50° MIN. *2
Actuator lever operating load	L	0.5g or more in the arrow-indicated direction as shown in the figure below

*1 Shielding light is defined as a condition with the actuator lever operating in the direction indicated by the arrow in the figure below in which the collector current (I_C) is reduced to 10% or less as compared to 100% for the condition in which the load on the actuator lever is 0g with the device mounted at the angle of 75±3°.

*2 If θ_2 comes into 48° or less, actuator lever causes to break or to transform due to holder touching.

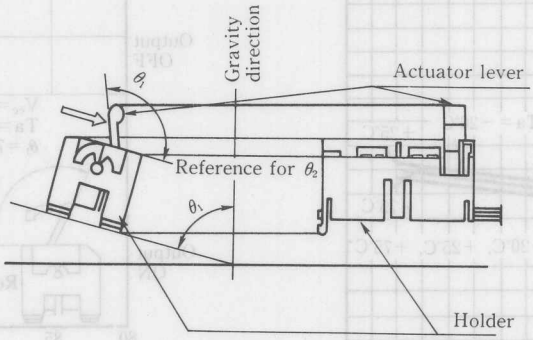


Fig. 1 Output Current vs. Ambient Temperature

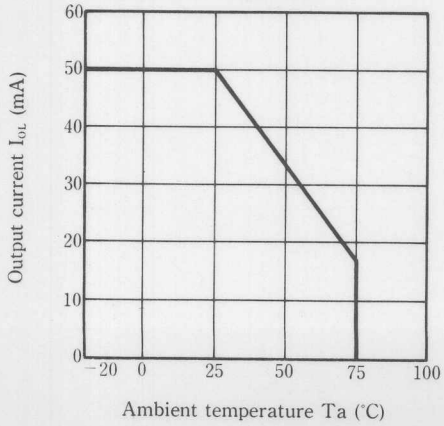
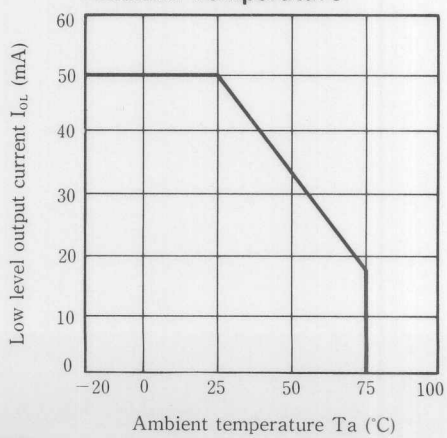


Fig. 2 Low Level Output Current vs. Ambient Temperature



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Fig. 3 Low Level Output Voltage vs. Low Level Output Current

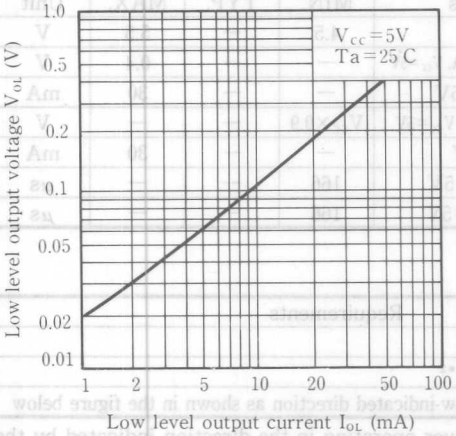


Fig. 4 Low Level Output Voltage vs. Ambient Temperature

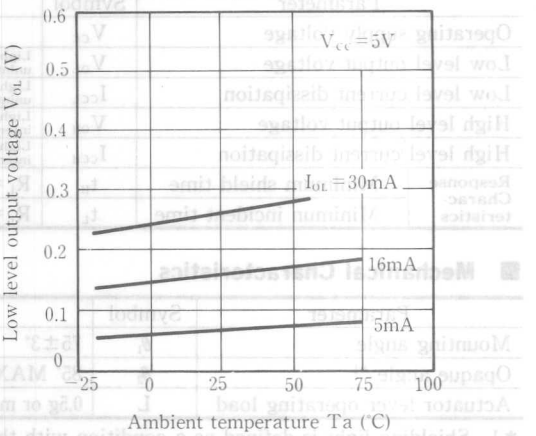


Fig. 5 Supply Current vs. Supply Voltage

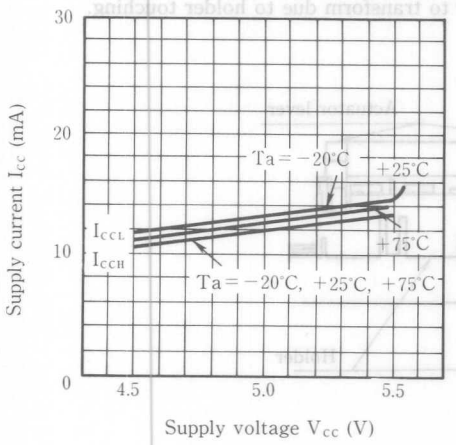
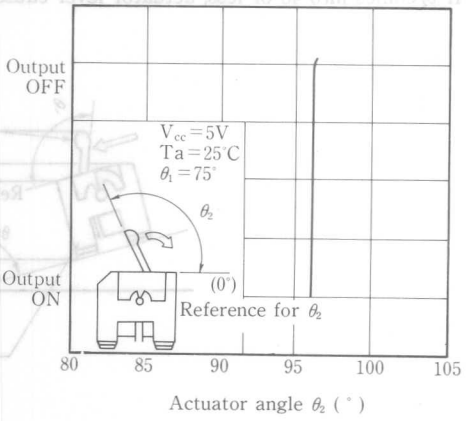


Fig. 6 Detecting Position Characteristics



GP1A50HR/GP1A51HR GP1A52HR

OPIC Photointerrupter

■ Features

1. High sensing accuracy (Slit width : 0.5mm)
2. LSTTL and TTL compatible output
3. Both-sides mounting type : GP1A50HR
   Either-side mounting type : GP1A51HR
   PWB mounting type : GP1A52HR

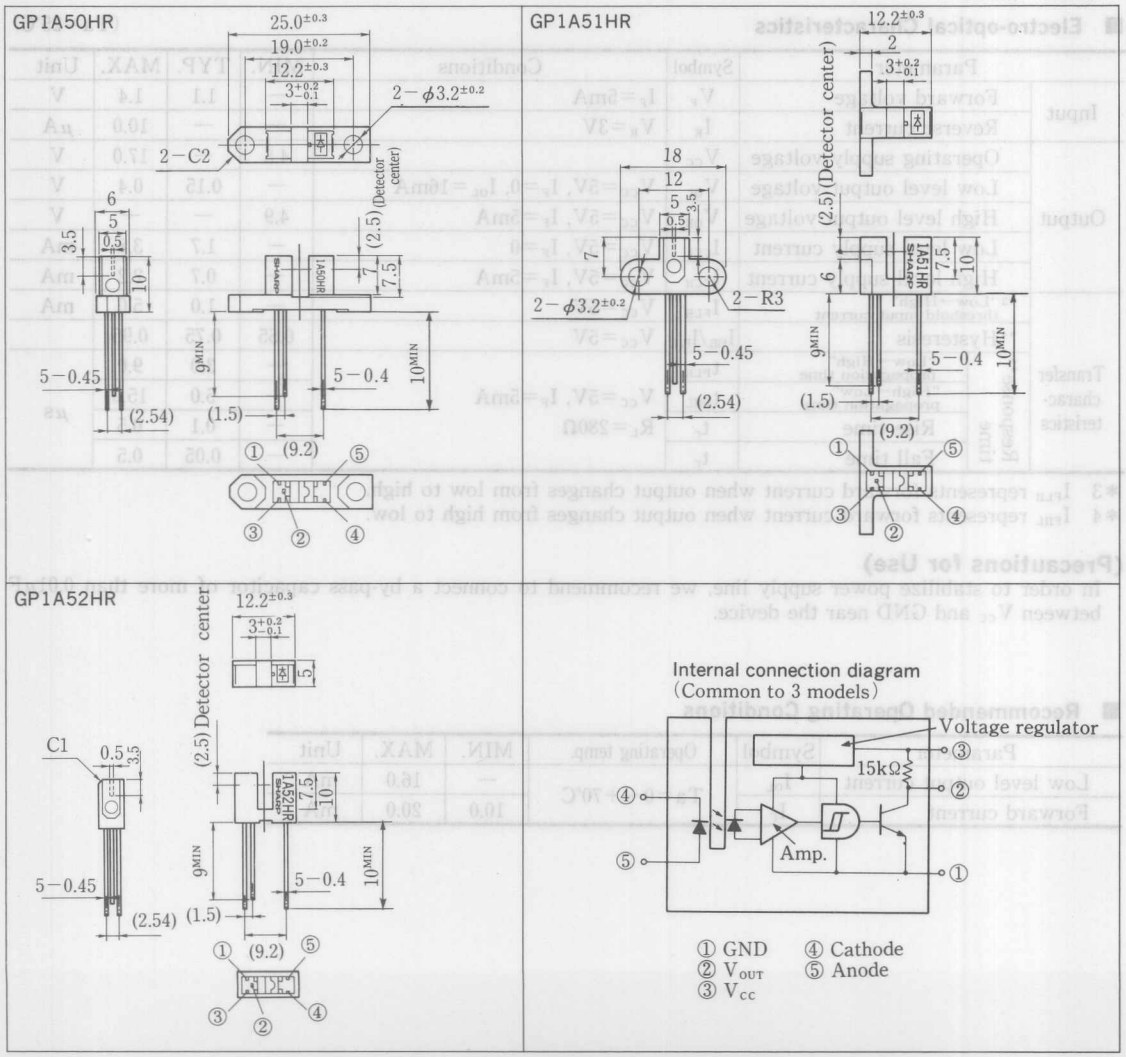
■ Applications

1. OA equipment, such as printers, facsimiles, etc.
2. VCRs

※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Outline Dimensions

(Unit : mm)



■ Absolute Maximum Ratings

(Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	W
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2 Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=5mA	—	1.1	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10.0	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17.0	V
	Low level output voltage		V_{OL}	V_{CC}=5V, I_F=0, I_{OL}=16mA	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=5mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	1.7	3.8	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=5mA	—	0.7	2.2	mA
Transfer characteristics	*3 "Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	1.0	5.0	mA
	*4 Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V	0.55	0.75	0.95	
	Response time*4	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=5mA, R_L=280Ω	—	3.0	9.0	μs
		"High→Low" propagation time	t_{PHL}		—	5.0	15.0	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_r		—	0.05	0.5	

*3 I_{FLH} represents forward current when output changes from low to high.
*4 I_{FHL} represents forward current when output changes from high to low.

(Precautions for Use)

In order to stabilize power supply line, we recommend to connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temp.	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0～+70°C	—	16.0	mA
Forward current	I_F		10.0	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

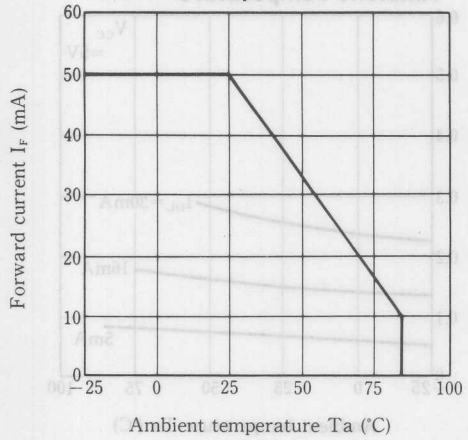


Fig. 2 Output Power Dissipation vs. Ambient Temperature

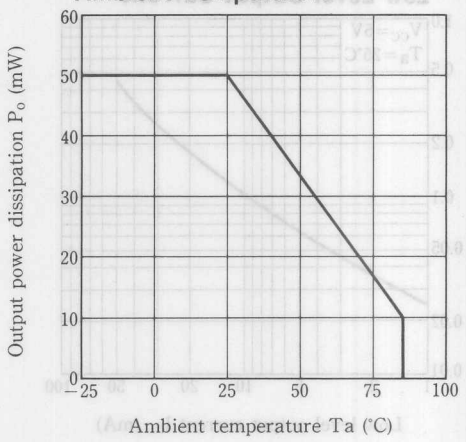


Fig. 3 Low Level Output Current vs. Ambient Temperature

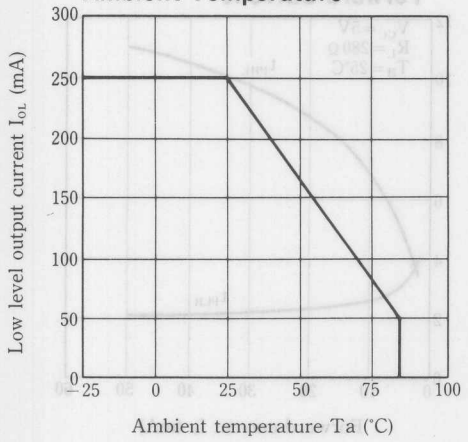


Fig. 4 Forward Current vs. Forward Voltage

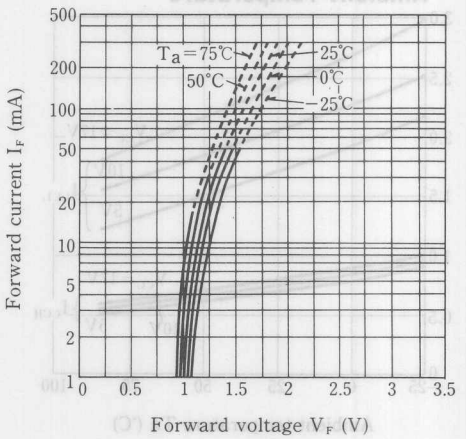


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

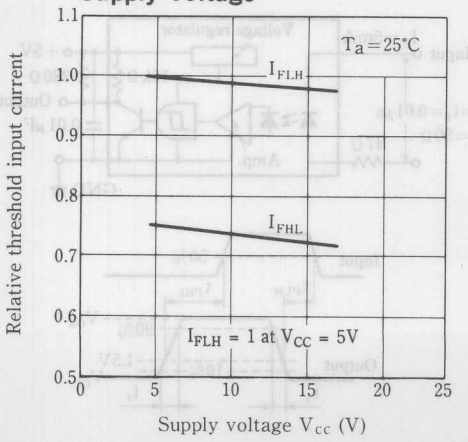
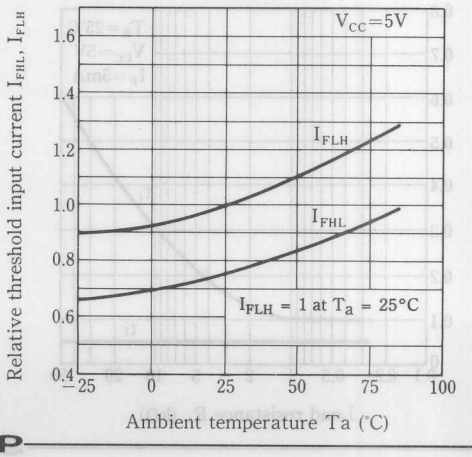


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature



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Fig. 7 Low Level Output Voltage vs. Low Level Output Current

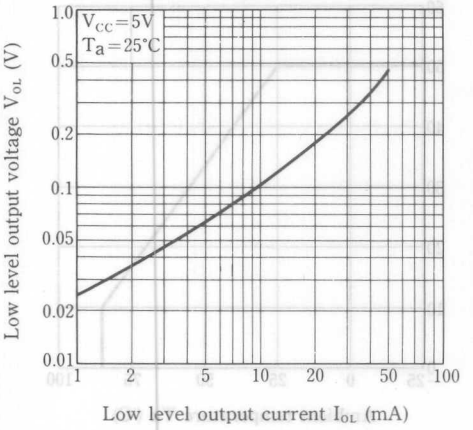


Fig. 8 Low Level Output Voltage vs. Ambient Temperature

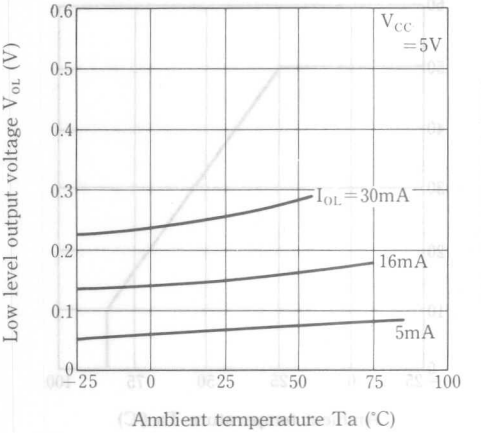


Fig. 9 Supply Current vs. Ambient Temperature

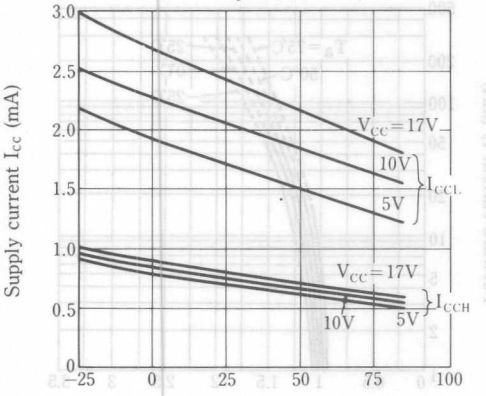


Fig. 10 Propagation Time vs. Forward Current

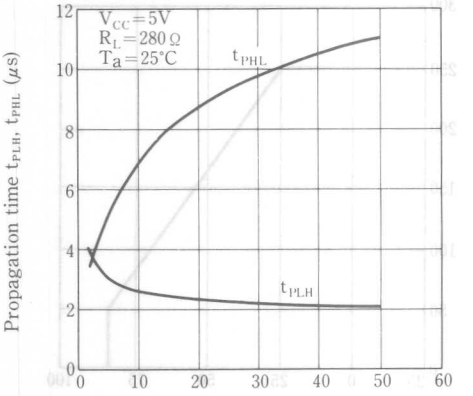
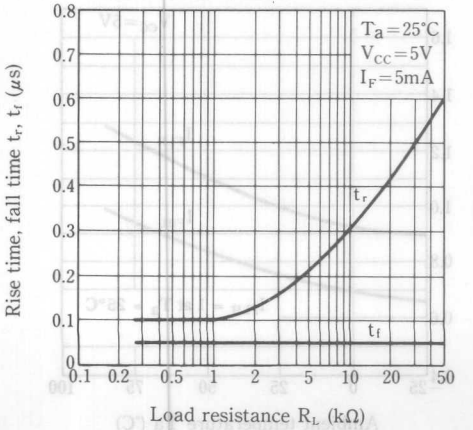
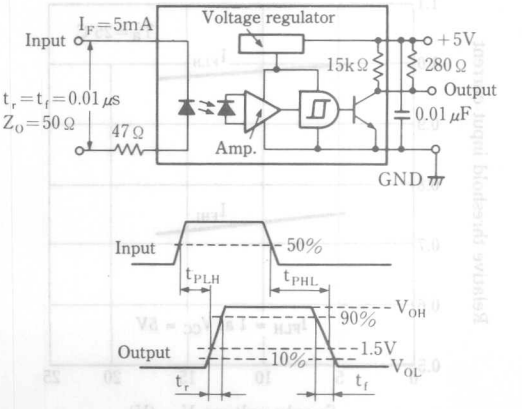


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time



GP1A52LR OPIC Photointerrupter

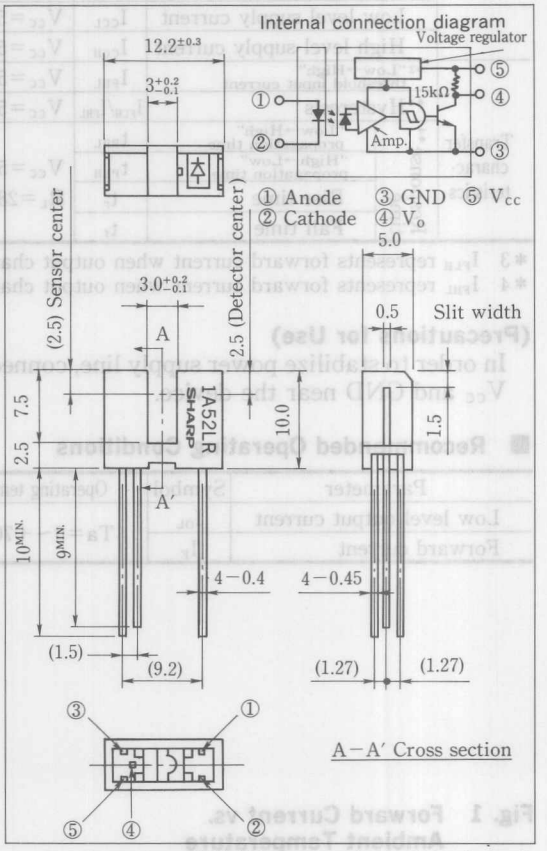
■ Features

1. Low cost type
2. High sensing accuracy (Slit width : 0.5mm)
3. TTL and CMOS compatible output
4. PWB mounting type

■ Applications

1. OA equipment, such as printers, floppy disk drives, etc
2. VCRs

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	W
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2 Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=5mA	—	1.1	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10.0	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17.0	V
	Low level output voltage		V_{OL}	V_{CC}=5V, I_F=0, I_{OL}=16mA	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=5mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	1.7	3.8	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=5mA	—	0.7	2.2	mA
Transfer characteristics	*3 "Low→High" threshold input current		I_{FHL}	V_{CC}=5V	—	1.0	5.0	mA
	*4 Hysteresis		I_{FLH}/I_{FHL}	V_{CC}=5V	0.55	0.75	0.95	
	Response time *4	"Low→High" propagation time	t_{PHL}	V_{CC}=5V, I_F=5mA, R_L=280Ω	—	3.0	9.0	μs
		"High→Low" propagation time	t_{PLH}		—	5.0	15.0	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output changes from low to high.
*4 I_{FHL} represents forward current when output changes from high to low.

(Precautions for Use)

In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temp.	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0~+70°C	—	16.0	mA
Forward current	I_F		10.0	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

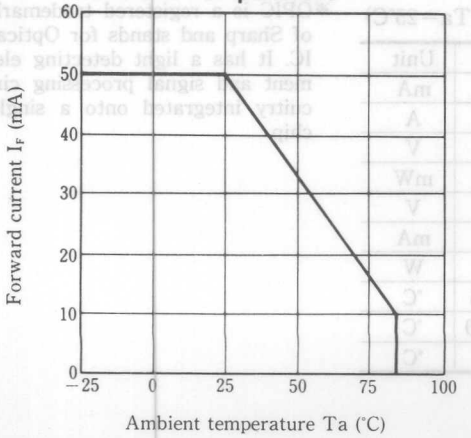


Fig. 2 Output Power Dissipation vs. Ambient Temperature

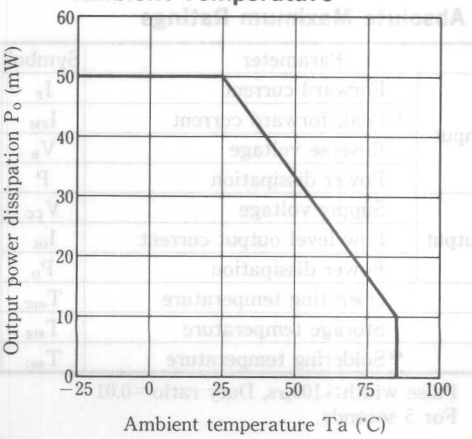


Fig. 3 Low Level Output Current vs. Ambient Temperature

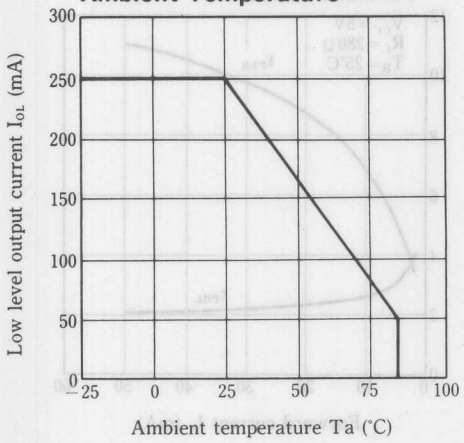


Fig. 4 Forward Current vs. Forward Voltage

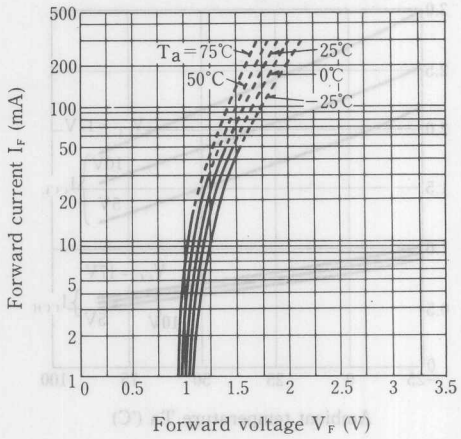


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

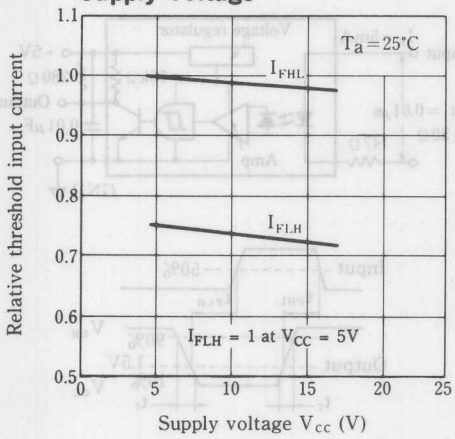


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

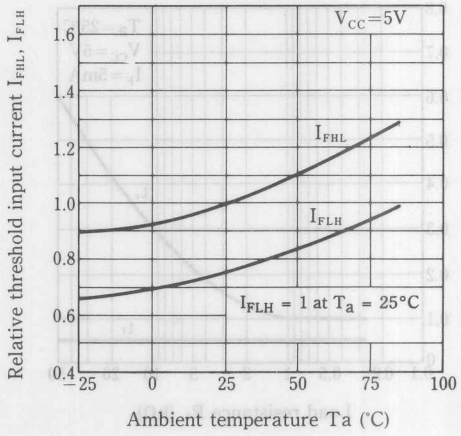


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

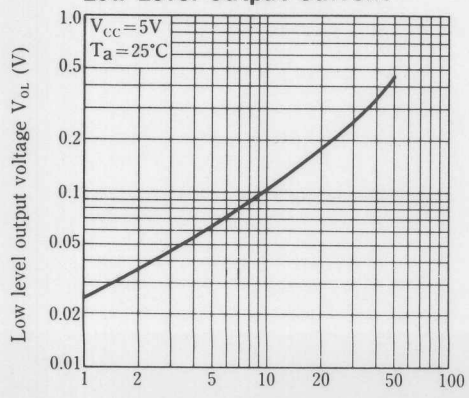
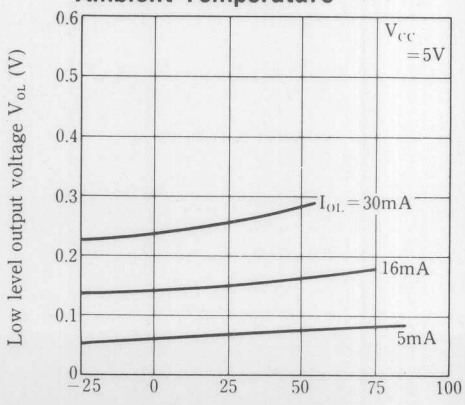


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



7

Fig. 9 Supply Current vs. Ambient Temperature

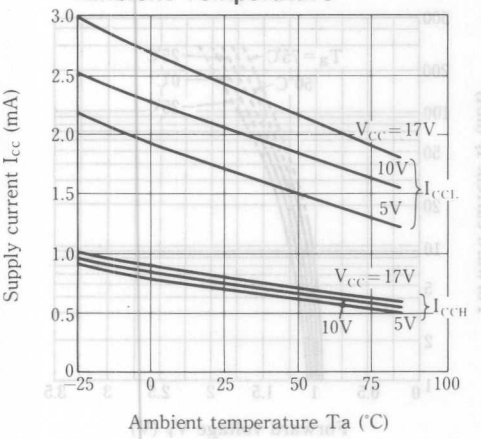


Fig. 10 Propagation Time vs. Forward Current

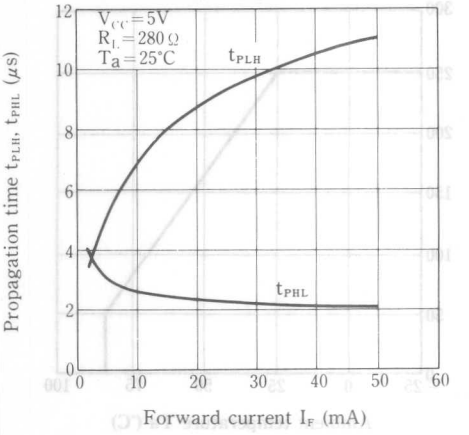
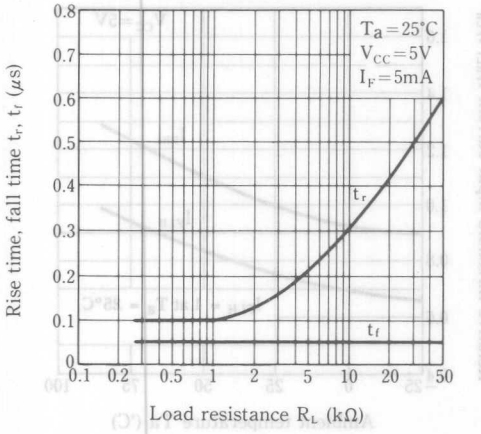
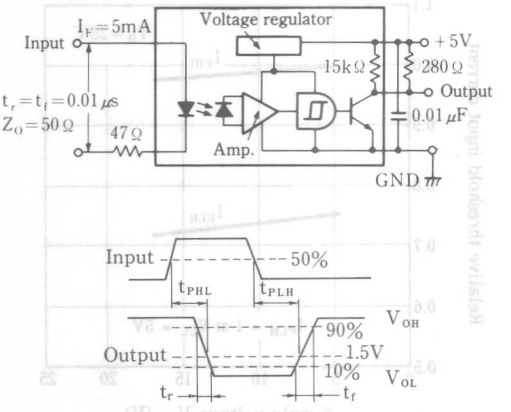


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time



GP1A53HR OPIC Photointerrupter

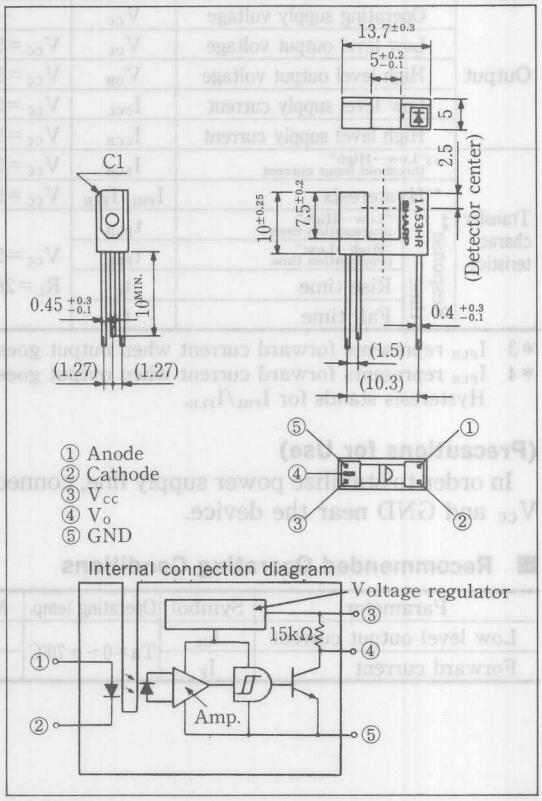
■ Features

1. High sensing accuracy (Slit width: 0.5mm)
2. TTL compatible output

■ Applications

1. OA equipment, such as printers, facsimiles, etc.
2. VCRs

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	W
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=8mA	—	1.14	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10.0	μA
Output	Operating supply voltage		V_{CC}	—	4.5	—	17.0	V
	Low level output voltage		V_{OL}	V_{CC}=5V, I_F=0, I_{OL}=16mA	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=8mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	1.7	3.8	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=8mA	—	0.7	2.2	mA
Transfer characteristics	*3"Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	1.5	8.0	mA
	*4Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V	0.55	0.75	0.95	
	Response time*4	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=8mA, R_L=280Ω	—	3.0	9.0	μs
		"High→Low" propagation time	t_{PHL}		—	5.0	15.0	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output goes from low to high.
*4 I_{FLH} represents forward current when output goes from high to low.
Hysteresis stands for I_{FHL}/I_{FLH}.

(Precautions for Use)

In order to stabilize power supply line, connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temp.	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0~+70°C	—	16.0	mA
Forward current	I_F		10.0	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

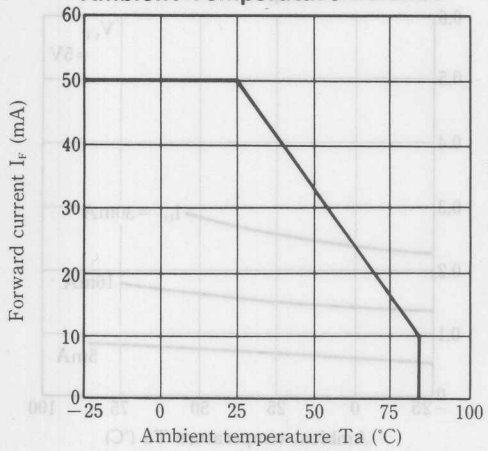


Fig. 2 Output Power Dissipation vs. Ambient Temperature

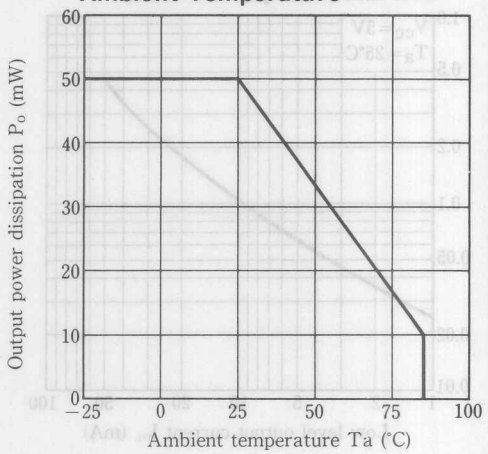


Fig. 3 Low Level Output Current vs. Ambient Temperature

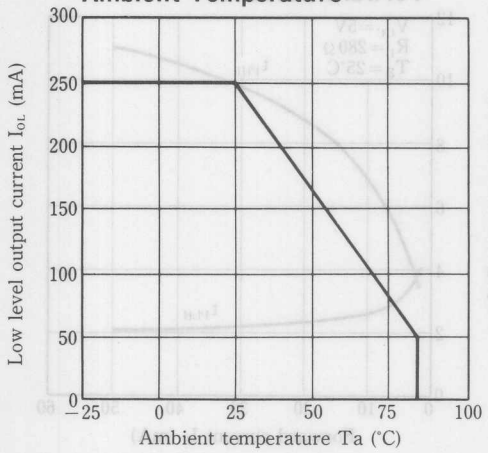


Fig. 4 Forward Current vs. Forward Voltage

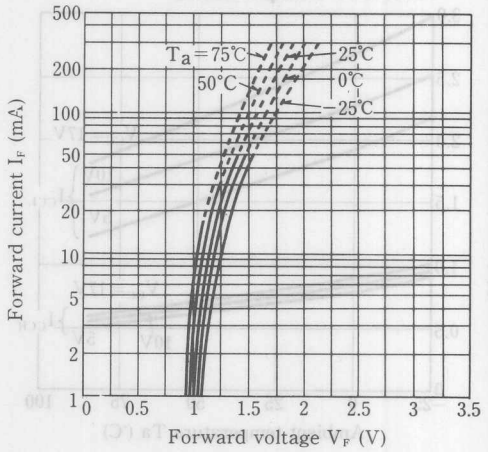


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

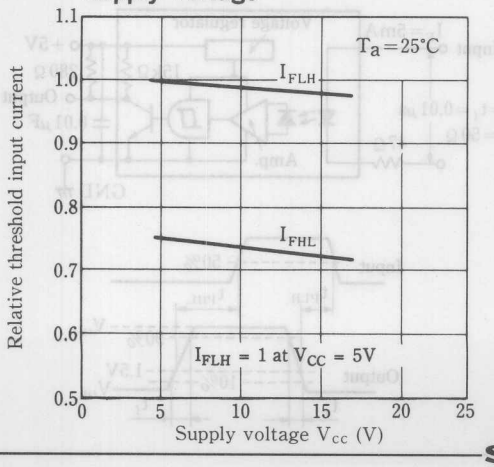
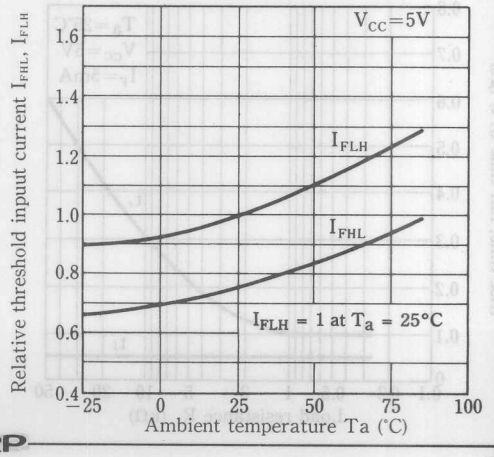


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature



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Fig. 7 Low Level Output Voltage vs. Low Level Output Current

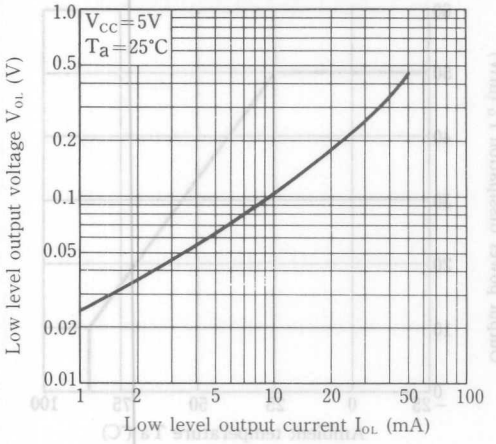


Fig. 8 Low level Output Voltage vs. Ambient Temperature

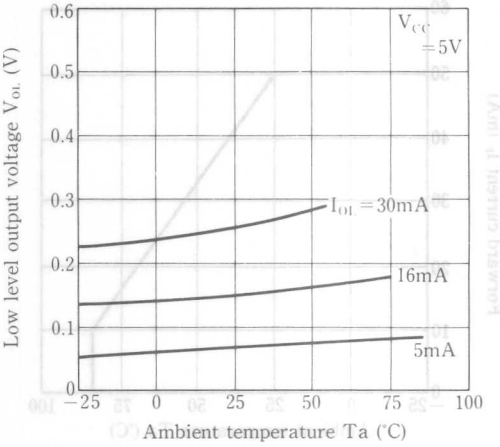


Fig. 9 Supply Current vs. Ambient Temperature

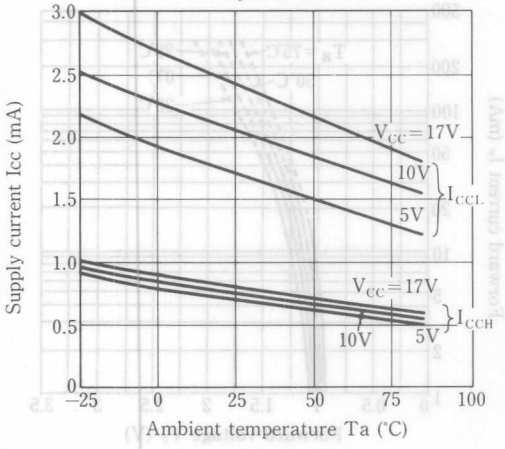


Fig. 10 Propagation Time vs. Forward Current

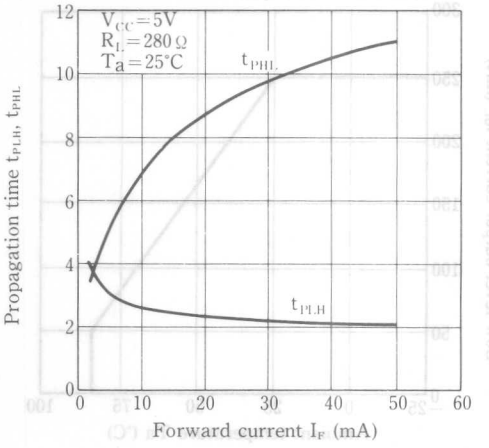
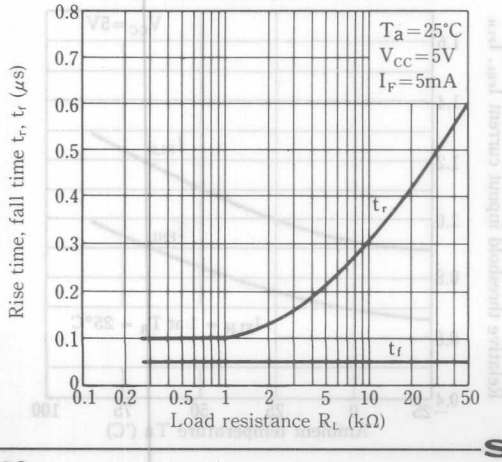
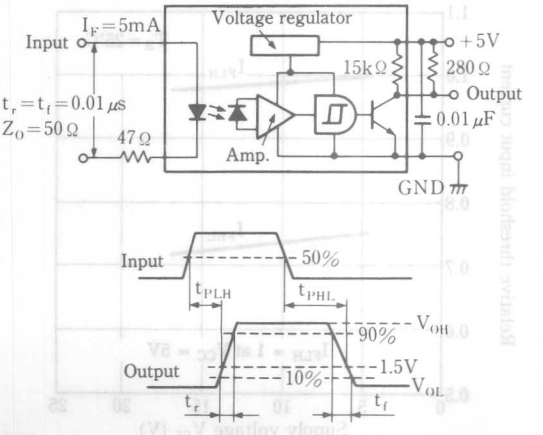


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time



GP1A57HR Wide Gap Type OPIC Photointerrupter

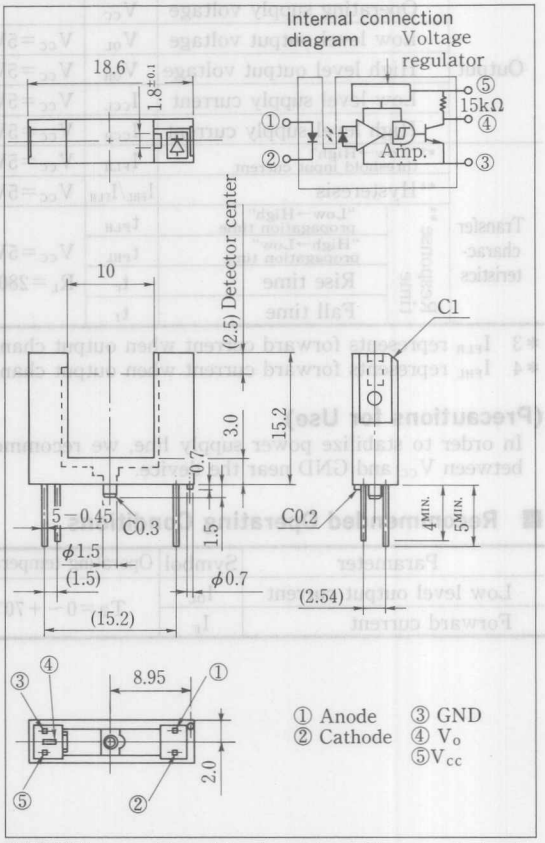
■ Features

1. Wide gap between LED and detector
2. High accuracy mounting type with positioning pin

■ Applications

1. Camera, video camera
2. OA equipment, such as copies etc.

■ Outline Dimensions (Unit : mm)



※OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings

(Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Supply voltage	V_{CC}	17	V
	Low level output current	I_{OL}	50	mA
	Power dissipation	P_O	250	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2 Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=7mA	—	1.1	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10.0	μA
Output	Operating supply voltage		V_{CC}		4.5	—	17.0	V
	Low level output voltage		V_{OL}	V_{CC}=5V, I_F=0, I_{OL}=16mA	—	0.15	0.4	V
	High level output voltage		V_{OH}	V_{CC}=5V, I_F=7mA	4.9	—	—	V
	Low level supply current		I_{CCL}	V_{CC}=5V, I_F=0	—	1.7	3.8	mA
	High level supply current		I_{CCH}	V_{CC}=5V, I_F=7mA	—	0.7	2.2	mA
Transfer characteristics	*3 "Low→High" threshold input current		I_{FLH}	V_{CC}=5V	—	1.0	5.0	mA
	*4 Hysteresis		I_{FHL}/I_{FLH}	V_{CC}=5V	0.55	0.75	0.95	
	Response time *4	"Low→High" propagation time	t_{PLH}	V_{CC}=5V, I_F=7mA, R_L=280Ω	—	3.0	9.0	μs
		"High→Low" propagation time	t_{PHL}		—	5.0	15.0	
		Rise time	t_r		—	0.1	0.5	
		Fall time	t_f		—	0.05	0.5	

*3 I_{FLH} represents forward current when output changes from low to high.
*4 I_{FHL} represents forward current when output changes from high to low.

(Precautions for Use)

In order to stabilize power supply line, we recommend to connect a by-pass capacitor of more than 0.01μF between V_{CC} and GND near the device.

■ Recommended Operating Conditions

Parameter	Symbol	Operating temperature	MIN.	MAX.	Unit
Low level output current	I_{OL}	Ta=0～+70°C	—	16.0	mA
Forward current	I_F		10.0	20.0	mA

Fig. 1 Forward Current vs. Ambient Temperature

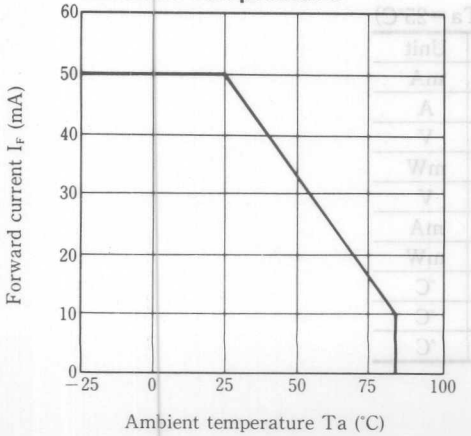


Fig. 2 Output Power Dissipation vs. Ambient Temperature

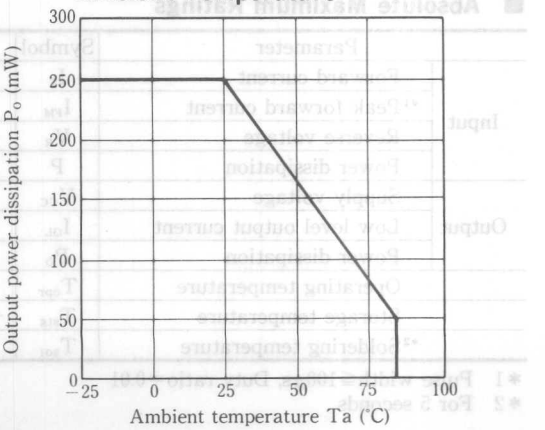


Fig. 3 Low Level Output Current vs. Ambient Temperature

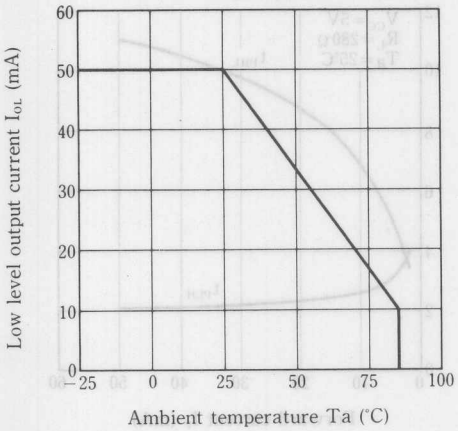


Fig. 4 Forward Current vs. Forward Voltage

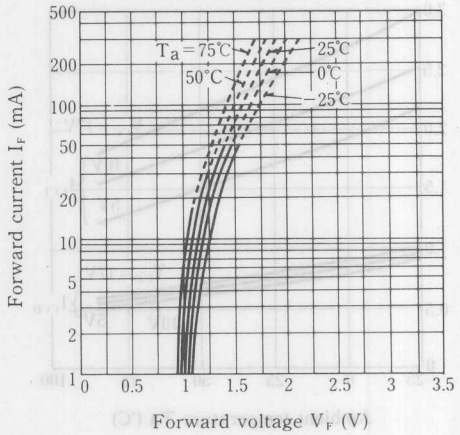


Fig. 5 Relative Threshold Input Current vs. Supply Voltage

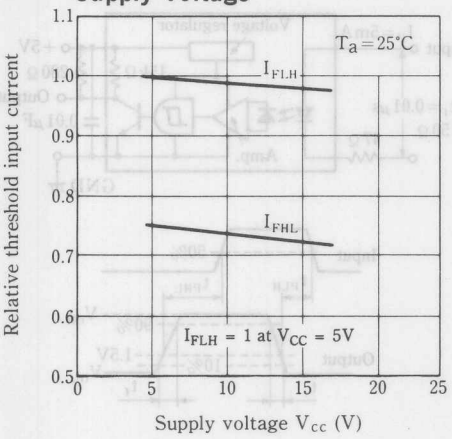


Fig. 6 Relative Threshold Input Current vs. Ambient Temperature

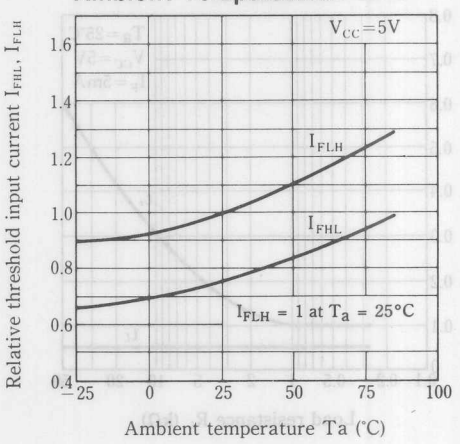


Fig. 7 Low Level Output Voltage vs. Low Level Output Current

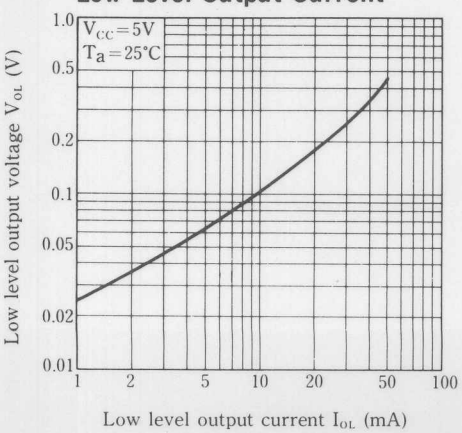
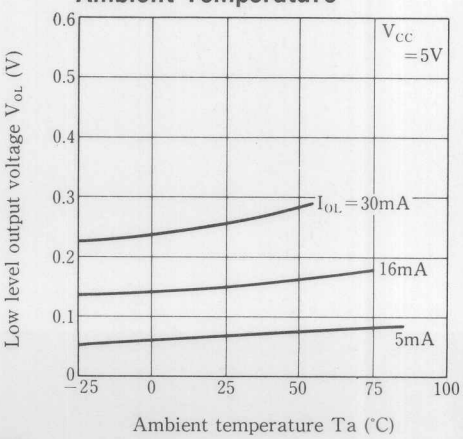


Fig. 8 Low Level Output Voltage vs. Ambient Temperature



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Fig. 9 Supply Current vs. Ambient Temperature

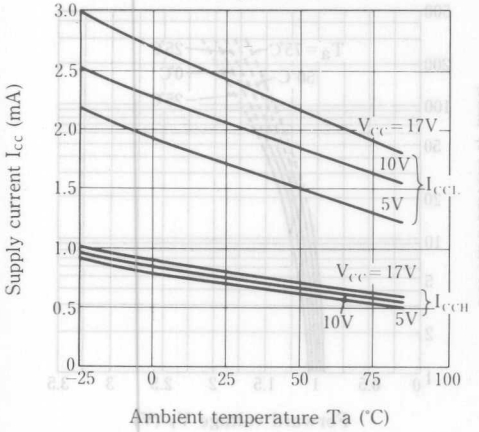


Fig. 10 Propagation Time vs. Forward Current

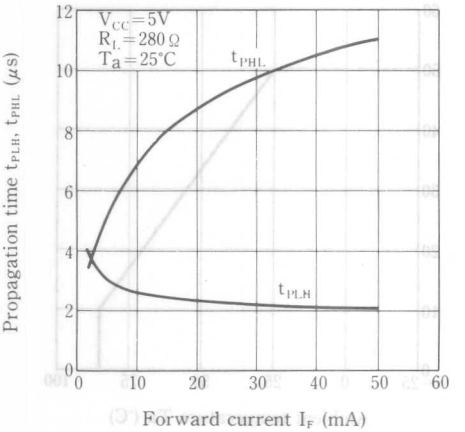
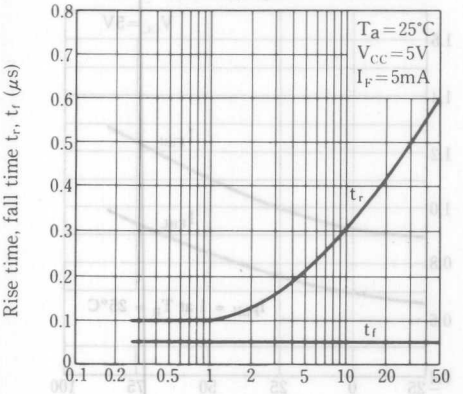
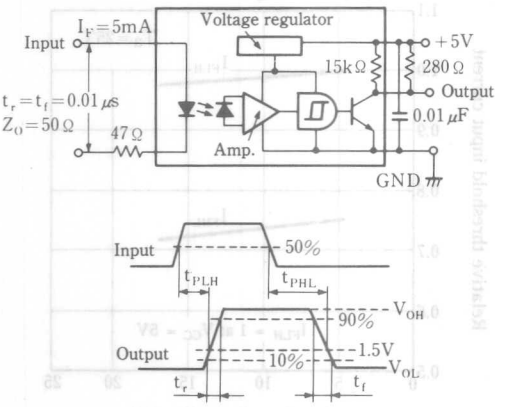


Fig. 11 Rise Time, Fall Time vs. Load Resistance



Test Circuit for Response Time



GP1S01/GP1S01F High Speed Photointerrupter

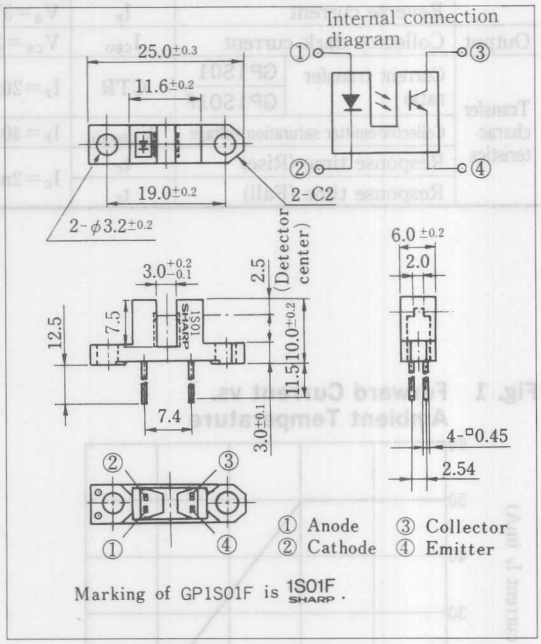
■ Features

1. High speed response (t_r : TYP. 3μs at R_L = 100Ω)
2. High current transfer ratio
   GP1S01 CTR : MIN. 10%
   GP1S01F CTR : MIN. 8%
   } at I_F = 20mA
3. Visible light cut-off type : GP1S01F

■ Applications

1. Copiers, printers, facsimiles
2. Record players, cassette decks
3. Speed warning device in automobile
4. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta = 25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25 ~ +85	°C
Storage temperature		T_{stg}	−40 ~ +100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width ≦ 100μs, Duty ratio = 0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage		V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Collector dark current		I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	GP1S01	CTR	I_F=20mA, V_{CE}=5V	10	20	150	%
		GP1S01F			8	20	120	%
	Collector-emitter saturation voltage		$V_{CE(sat)}$	I_F=40mA, I_C=1mA	—	—	0.4	V
	Response time (Rise)		t_r	I_C=2mA, V_{CE}=2V, R_L=100Ω	—	3	15	μs
	Response time (Fall)		t_f		—	4	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

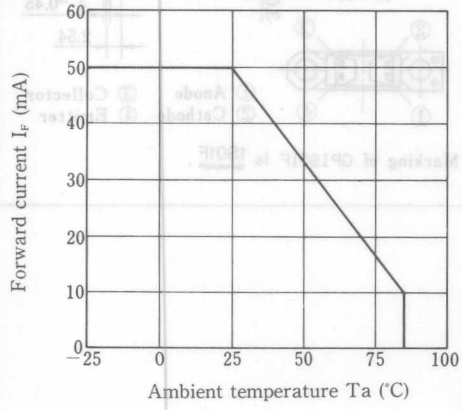


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

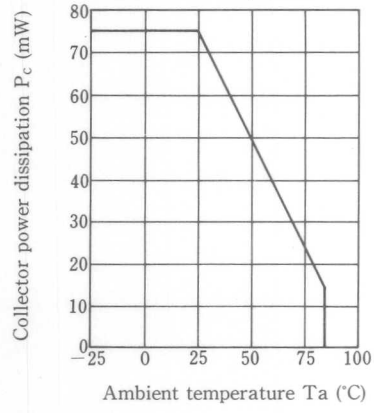


Fig. 3 Peak Forward Current vs. Duty Ratio

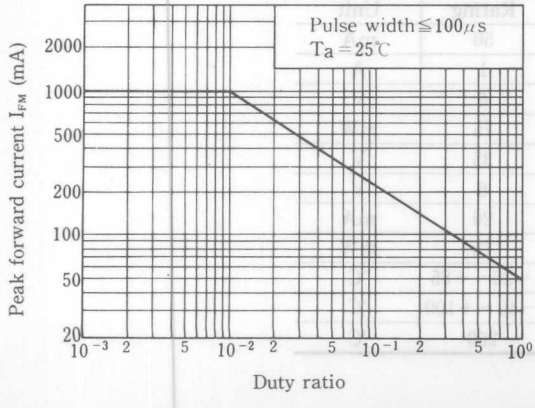


Fig. 4 Forward Current vs. Forward Voltage

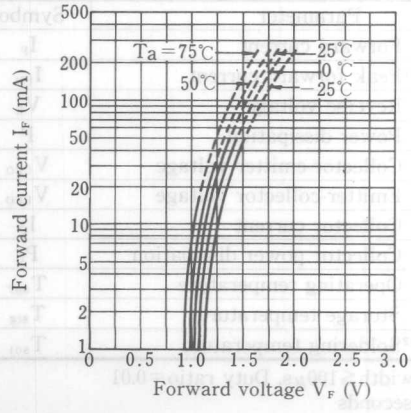


Fig. 5 Collector Current vs. Forward Current

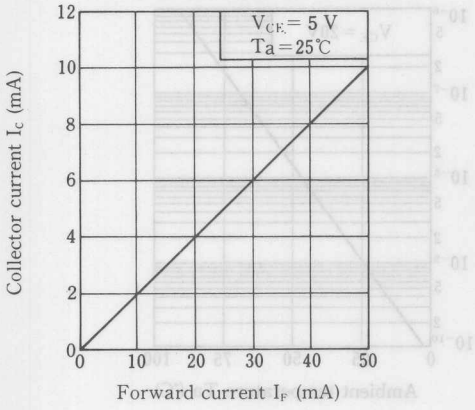


Fig. 6 Collector Current vs. Collector-emitter Voltage

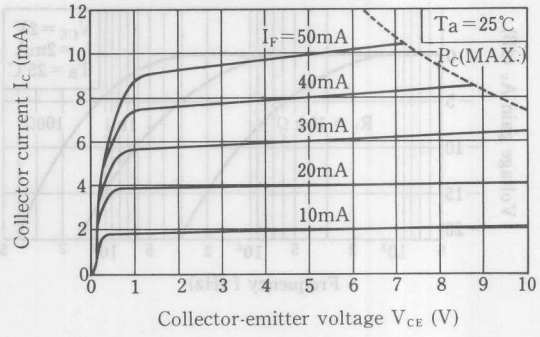


Fig. 7 Collector Current vs. Ambient Temperature

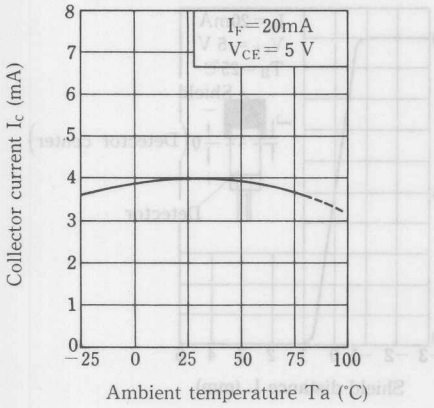


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

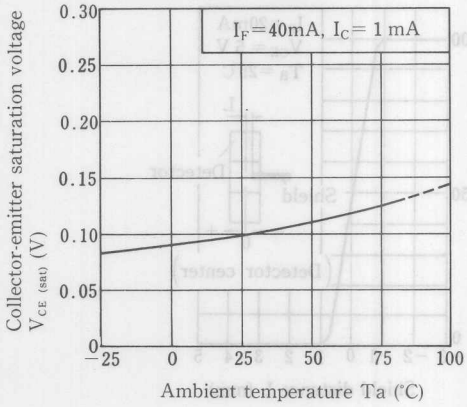
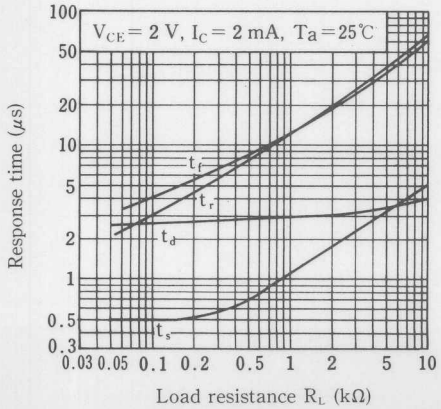
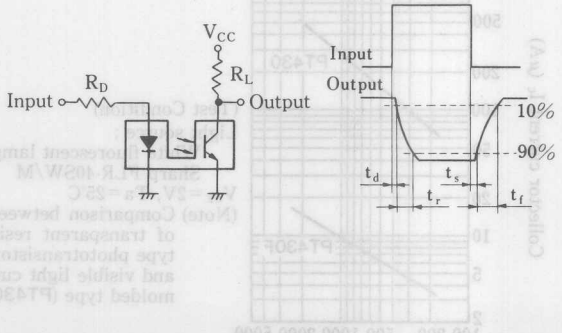


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

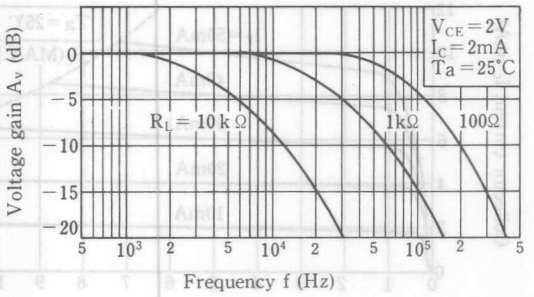


Fig. 11 Collector Dark Current vs. Ambient Temperature

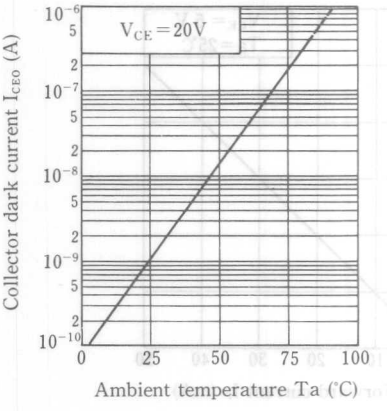


Fig. 12 Relative Collector Current vs. Shield Distance (1)

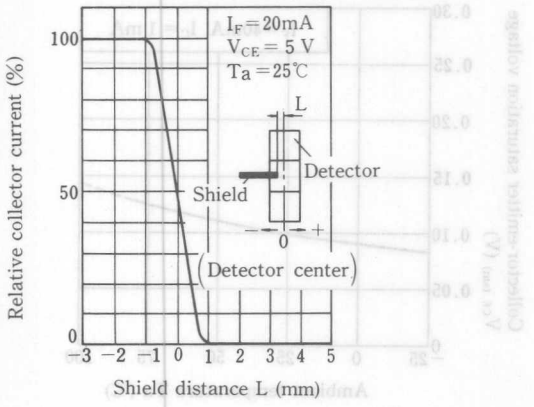


Fig. 13 Relative Collector Current vs. Shield Distance (2)

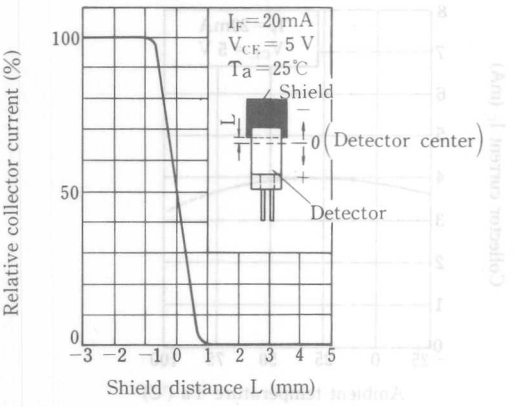
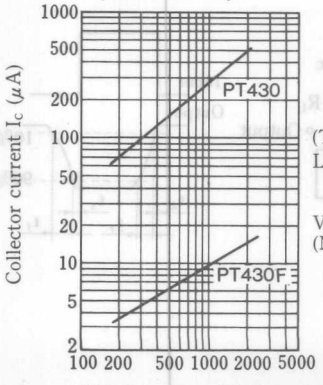


Fig. 14 Collector Current vs. Illuminance (Reference)



(Test Condition)
Light source :
White fluorescent lamp
Sharp FLR-40SW/M
V_{CE} = 2V, Ta = 25°C
(Note) Comparison between outputs of transparent resin molded type phototransistor (PT430) and visible light cut-off resin molded type (PT430F)

GP1S05 Wide Gap, High Sensing Accuracy Type Photointerrupter

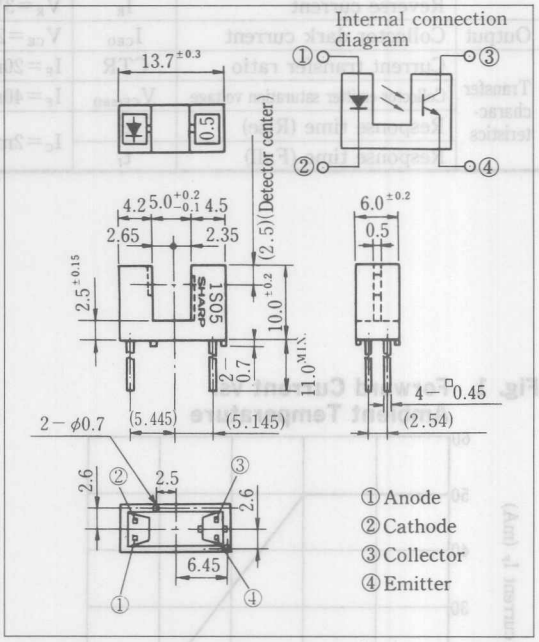
■ Features

1. High sensing accuracy (Slit width : 0.5mm)
2. Gap between LED and detector : 5mm
3. High speed response (t_r : TYP. 3μs at $R_L = 100\Omega$)
4. PWB direct mounting type package

■ Applications

1. Copiers, printers, facsimiles
2. VCRs, cassette decks
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	2.5	—	75	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=0.2mA	—	—	0.4	V
	Response time (Rise)	t_r	I_C=2mA, V_{CE}=2V, R_L=100Ω	—	3	15	μs
	Response time (Fall)	t_f		—	4	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

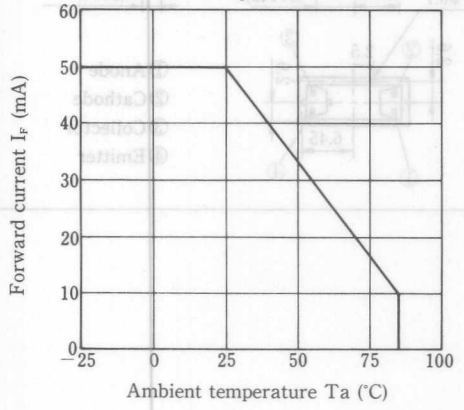


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

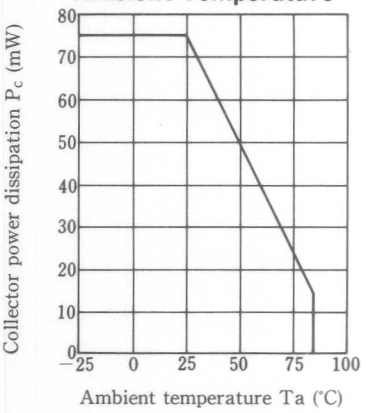


Fig. 3 Peak Forward Current vs. Duty Ratio

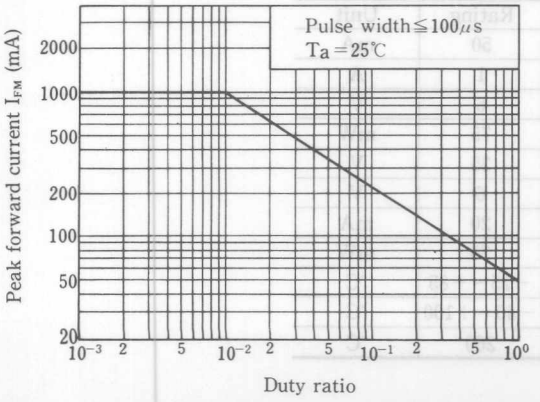


Fig. 4 Forward Current vs. Forward Voltage

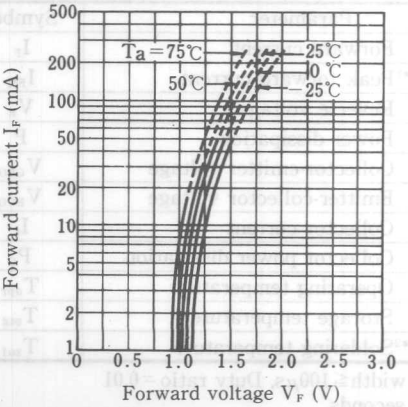


Fig. 5 Collector Current vs. Forward Current

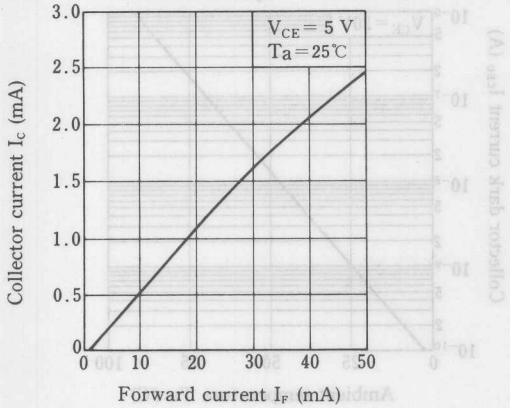


Fig. 6 Collector Current vs. Collector-emitter Voltage

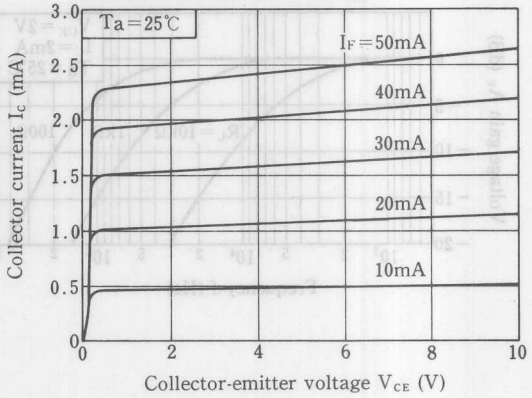


Fig. 7 Collector Current vs. Ambient Temperature

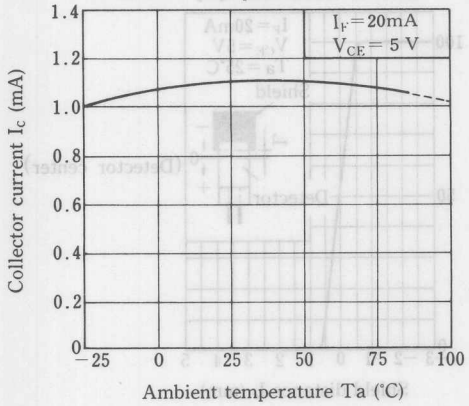


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

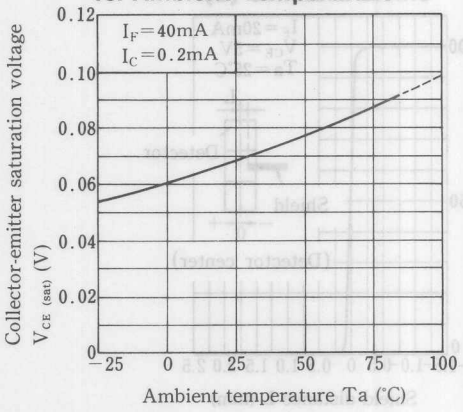
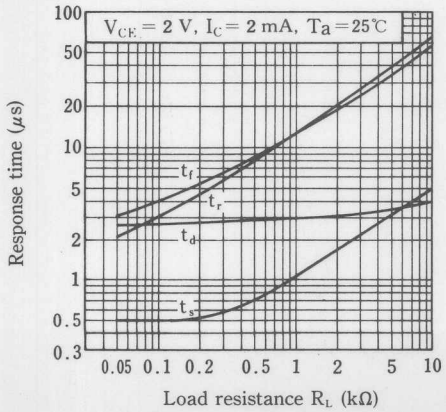
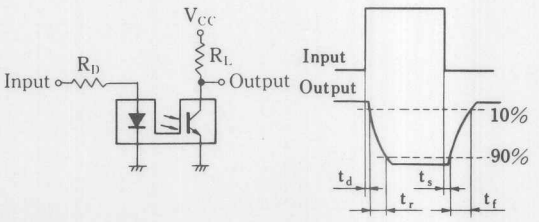


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

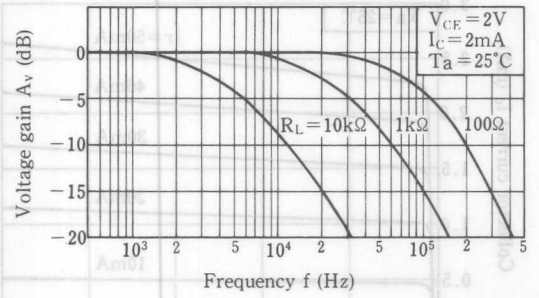


Fig. 11 Collector Dark Current vs. Ambient Temperature

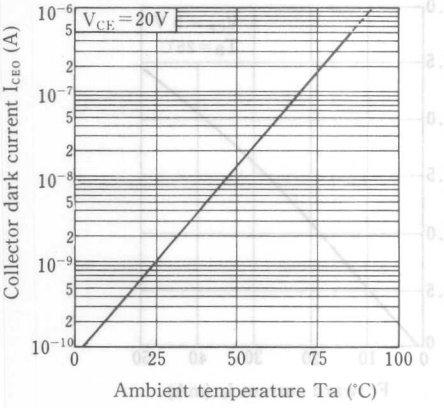


Fig. 12 Relative Collector Current vs. Shield Distance (1)

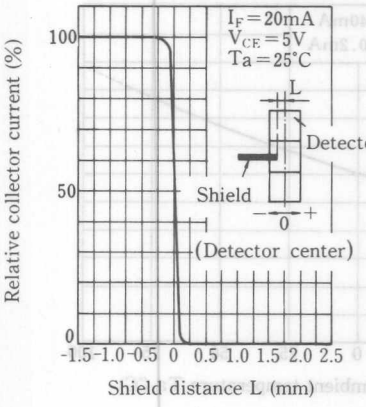
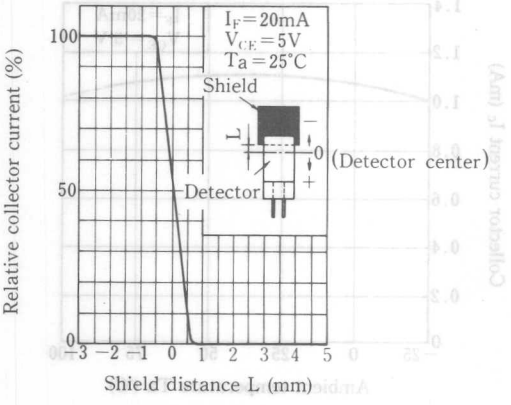


Fig. 13 Relative Collector Current vs. Shield Distance (2)



GP1S06 High Sensing Accuracy Type Photointerrupter

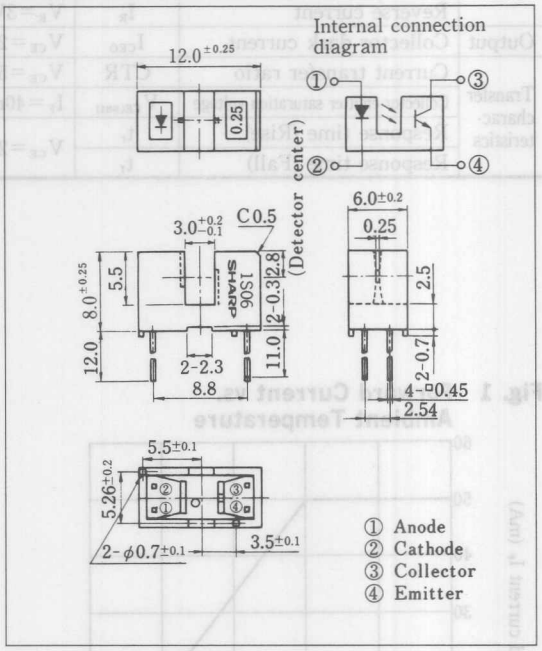
■ Features

1. High sensing accuracy
   (Slit width : 0.25mm)
2. PWB mounting type package

■ Applications

1. Floppy disk drives
2. Copiers, printers, facsimiles
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	V_{CE}=5V, I_F=20mA	0.5	—	12.5	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=50μA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=0.5mA, R_L=1kΩ	—	38	90	μs
	Response time (Fall)	t_f		—	48	110	μs

Fig. 1 Forward Current vs. Ambient Temperature

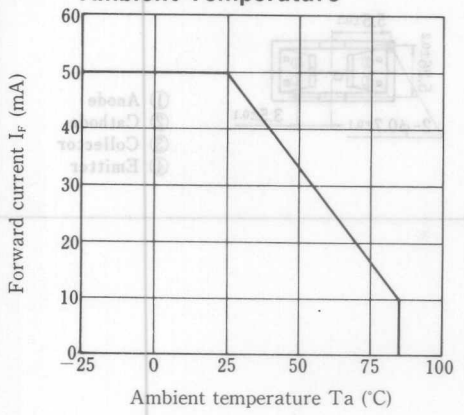


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

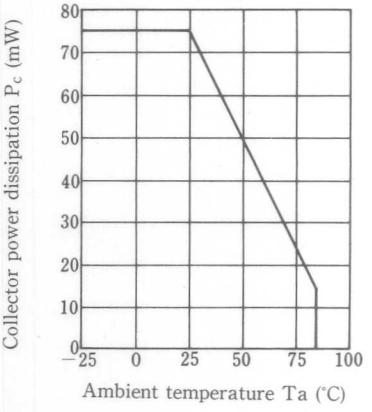


Fig. 3 Peak Forward Current vs. Duty Ratio

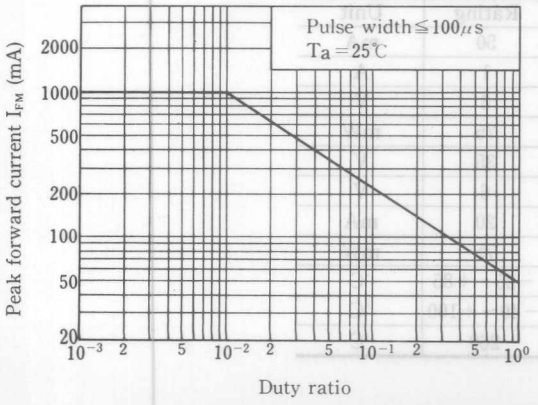


Fig. 4 Forward Current vs. Forward Voltage

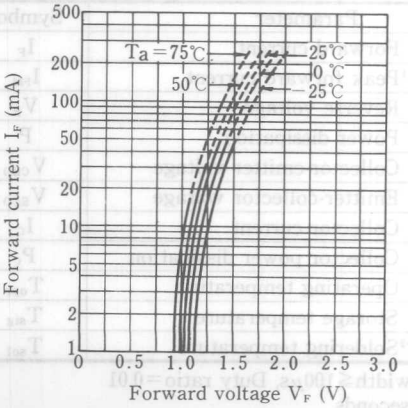


Fig. 5 Collector Current vs. Forward Current

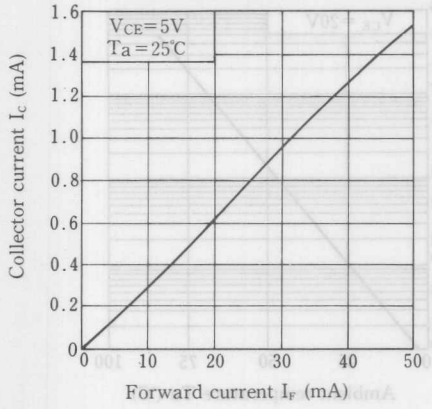


Fig. 6 Collector Current vs. Collector-emitter Voltage

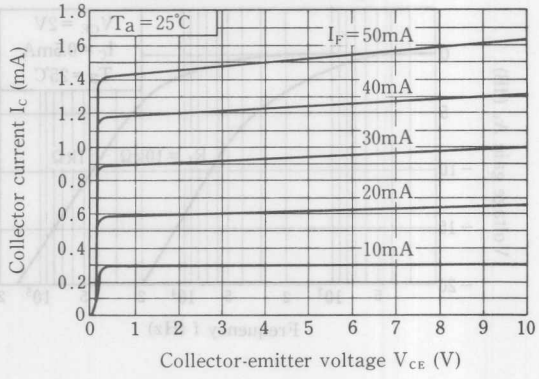


Fig. 7 Collector Current vs. Ambient Temperature

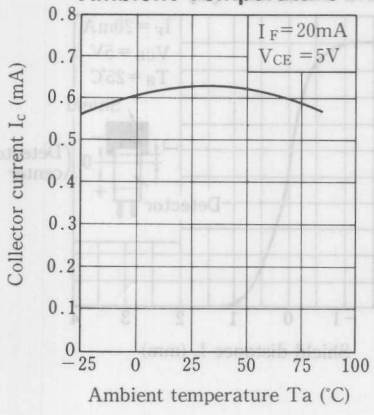


Fig. 8 Collector-emiter Saturation Voltage vs. Ambient Temperature

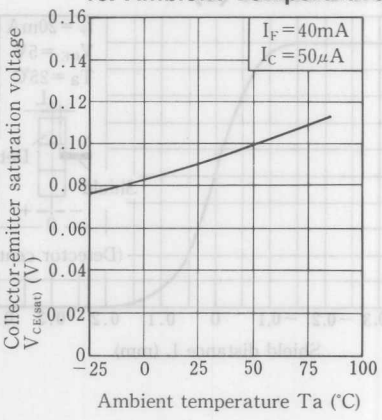
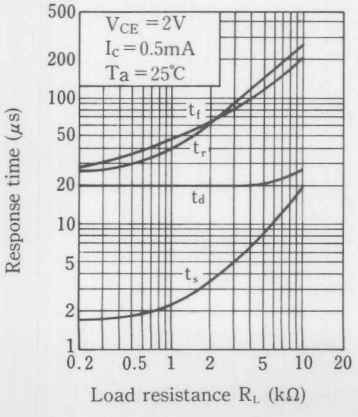
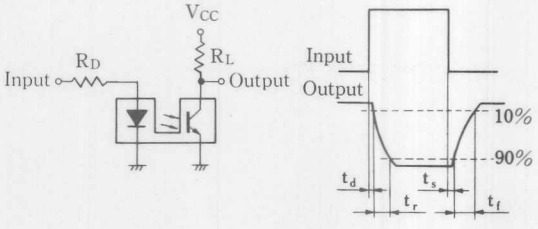


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

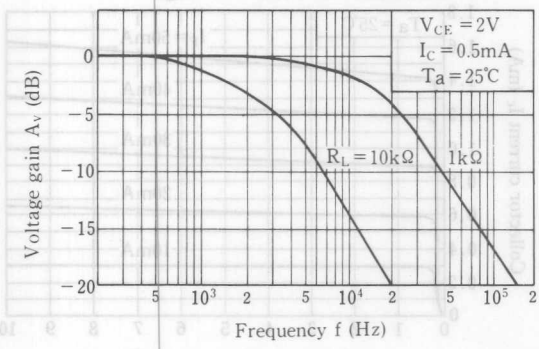


Fig. 11 Collector Dark Current vs. Ambient Temperature

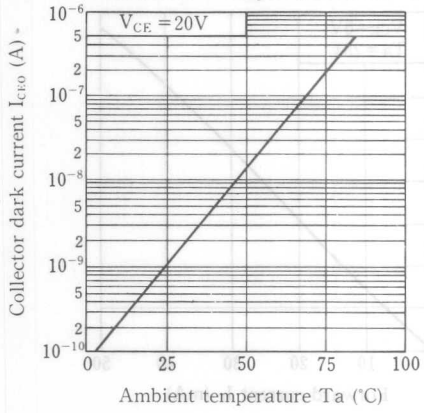


Fig. 12 Relative Collector Current vs. Shield Distance (1)

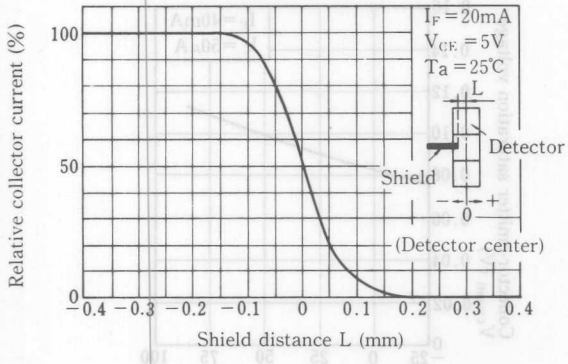
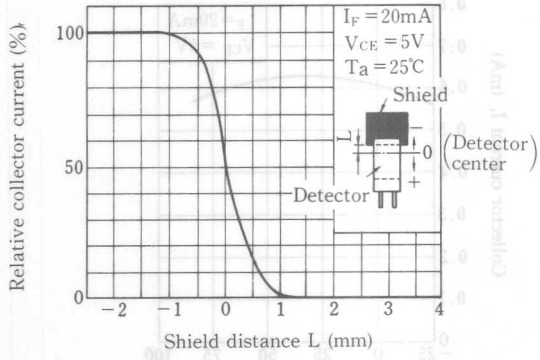


Fig. 13 Relative Collector Current vs. Shield Distance (2)



GP1S07 Subminiature Photointerrupter

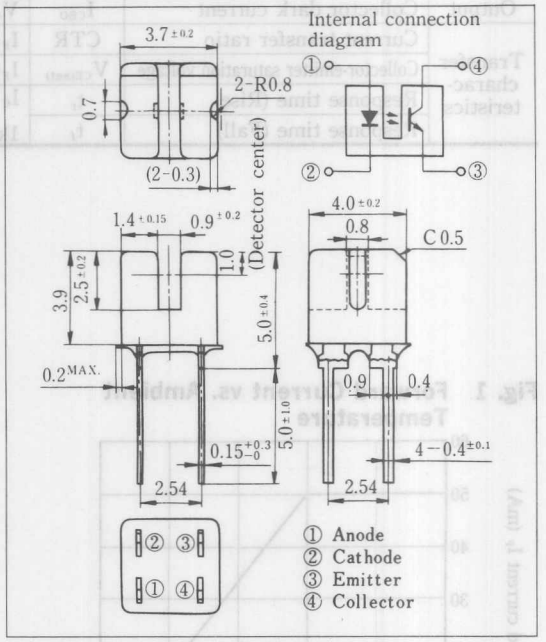
■ Features

1. Ultra-colmpact (Capacity: 0.06cc) and light
2. PWB mounting type package
3. High sensing accuracy (Slit width: 0.8mm)

■ Applications

1. Still camera
2. Miniprinter
3. Microfloppy disk
4. Compact equipment

■ Outline Dimensions (Unit: mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipatioo	P_C	75	mW
	Total power dissipation	P_{tot}	100	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*1Soldering temperature	T_{sol}	260	°C

*1 For 3 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1.5mA, V_{CE}=5V	4.3	7.3	13.3	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=3mA, I_C=30μA	—	0.08	0.4	V
	Response time (Rise)	t_r	I_C=0.1mA, V_{CE}=5V, R_L= 1kΩ	—	50	150	μs
	Response time (Fall)	t_f		—	50	150	μs

Fig. 1 Forward Current vs. Ambient Temperature

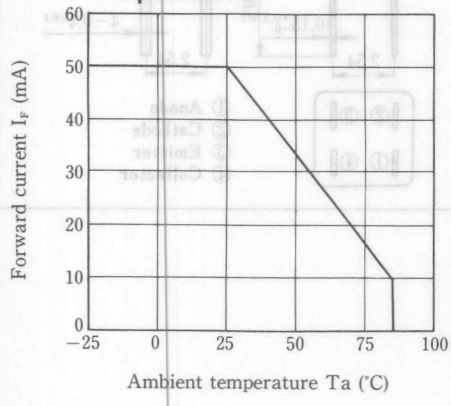


Fig. 2 Power Dissipation vs. Ambient Temperature

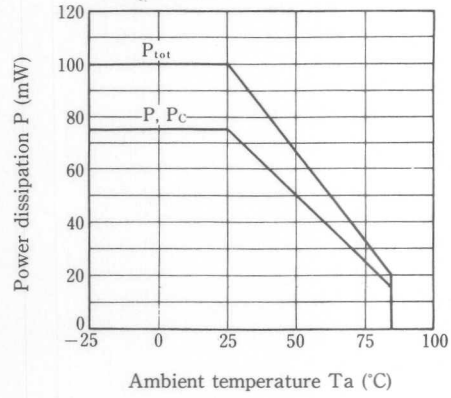


Fig. 3 Forward Current vs. Forward Voltage

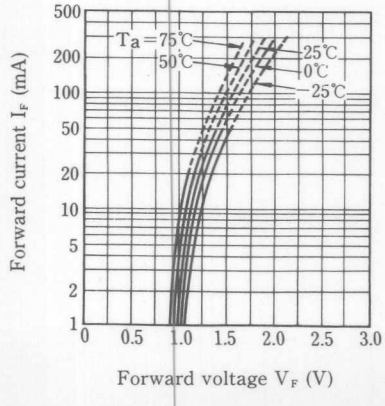


Fig. 4 Collector Current vs. Forward Current

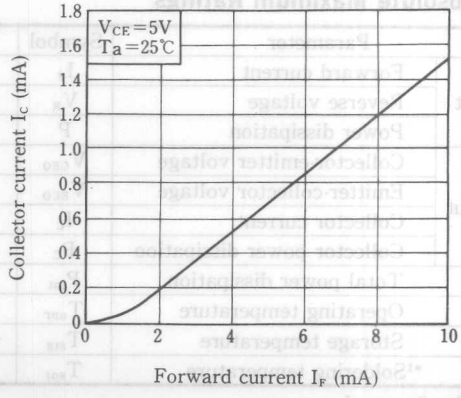


Fig. 5 Collector Current vs. Collector-emitter Voltage

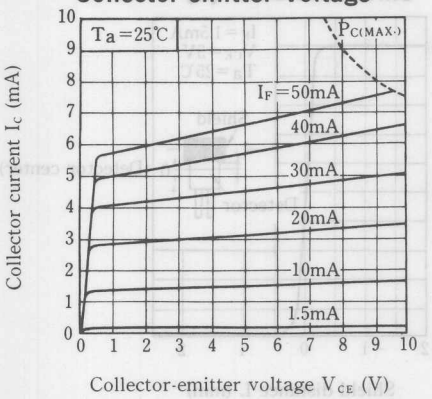


Fig. 6 Collector Current vs. Ambient Temperature

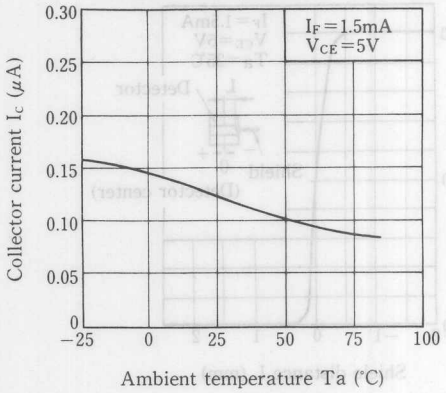


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

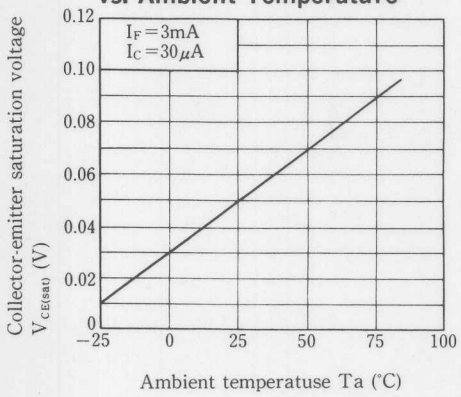


Fig. 8 Collector Dark Current vs. Ambient Temperature

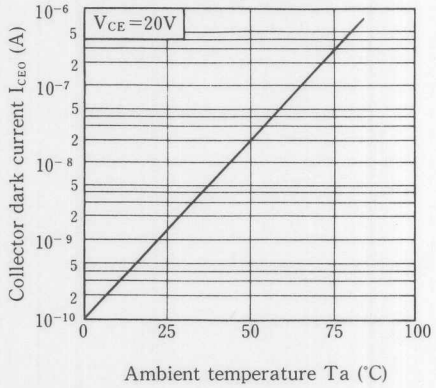
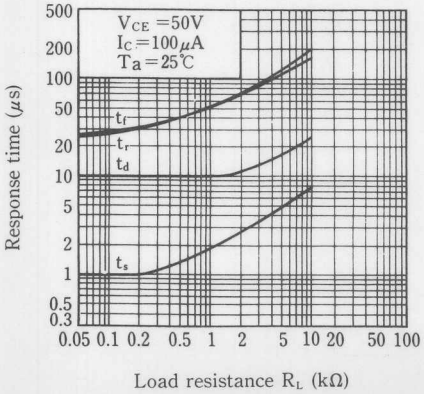
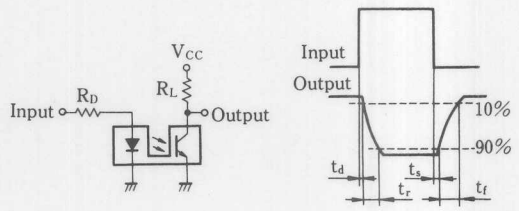


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



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Fig. 10 Relative Collector Current vs. Shield Distance (1)

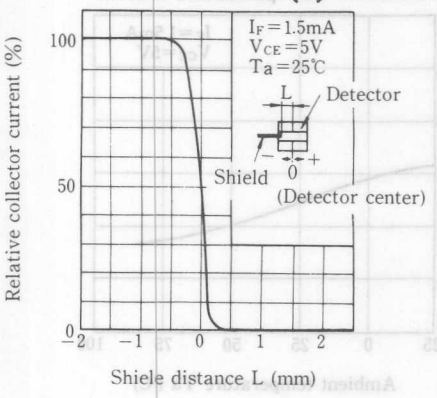
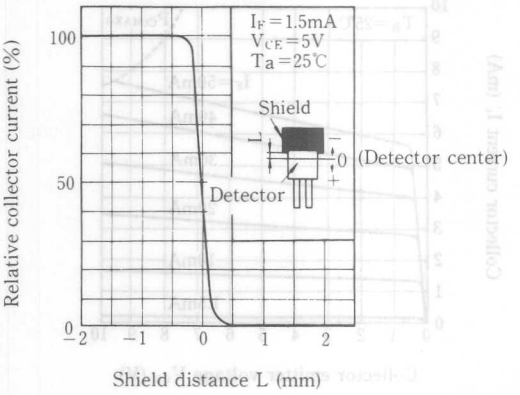


Fig. 11 Relative Collector Current vs. Shield Distance (2)



GP1S09 Photointerrupter with Connector

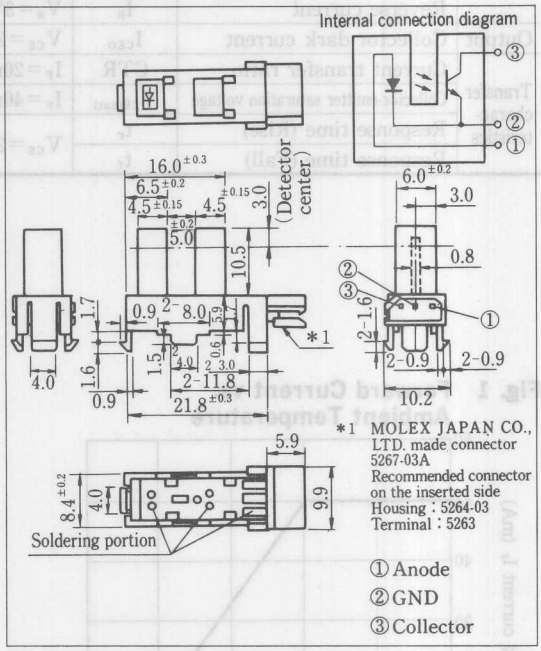
■ Features

1. Snap-in mounting type
2. Can be mounted on 2 different thickness boards (1.0mm, 1.6mm)
3. 3-pin connector terminal
4. Wide gap between light emitter and detector (5mm)

■ Applications

1. Copiers
2. Printers
3. Facsimiles

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse Voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+75	°C
	*2Storage temperature	T_{stg}	−40～+85	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 The connector should be plugged in/out and the unit's hook should be used at normal temperature.

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	2.5	—	75	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=1mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	3	15	μs
	Response time (Fall)	t_f		—	4	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

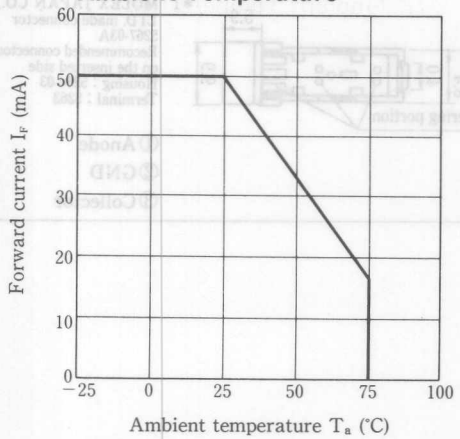


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

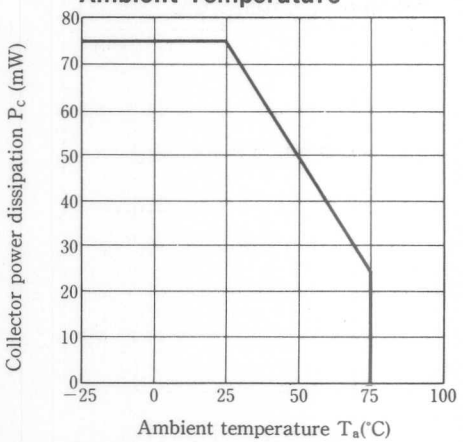


Fig. 3 Peak Forward Current vs. Duty Ratio

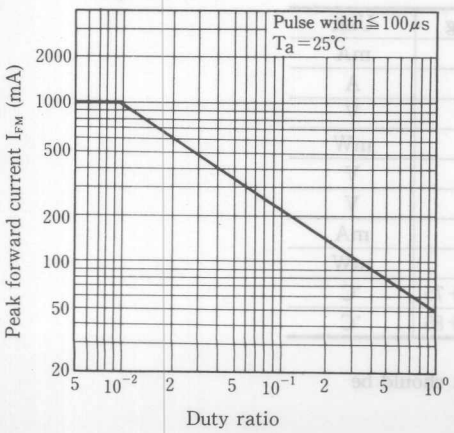


Fig. 4 Forward Current vs. Forward Voltage

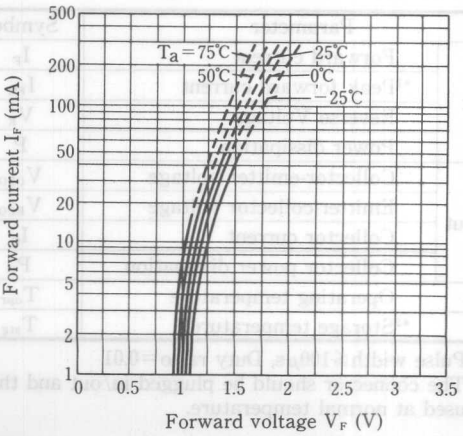


Fig. 5 Collector Current vs. Forward Current

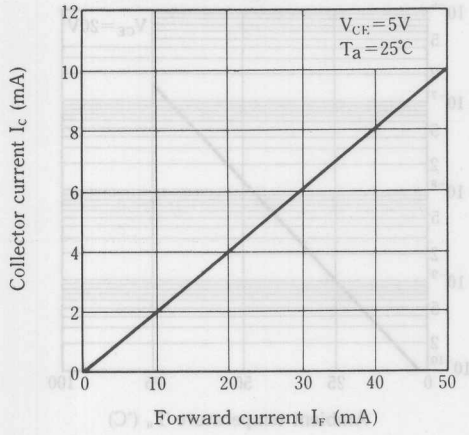


Fig. 6 Collector Current vs. Collector-emitter Voltage

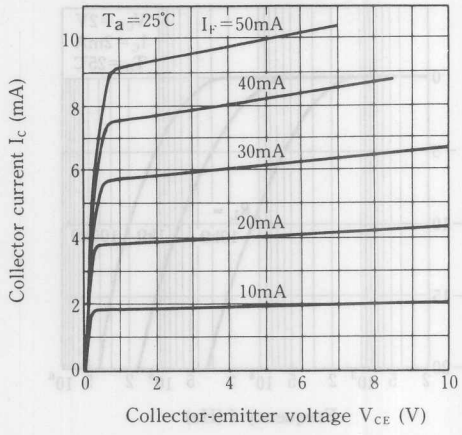


Fig. 7 Collector Current vs. Ambient Temperature

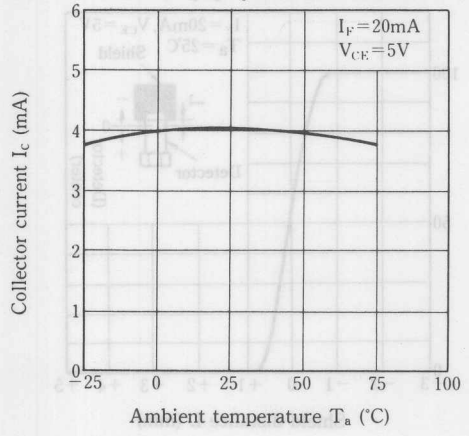


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

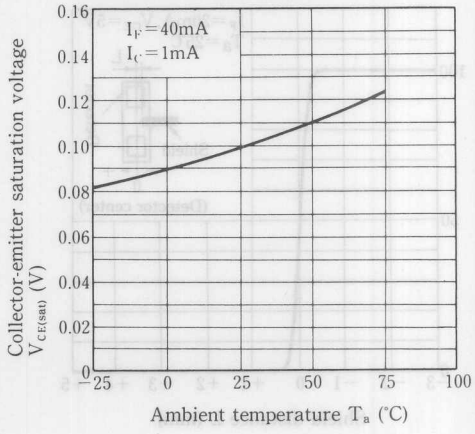
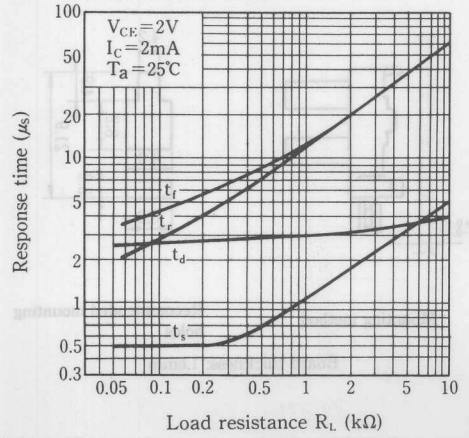
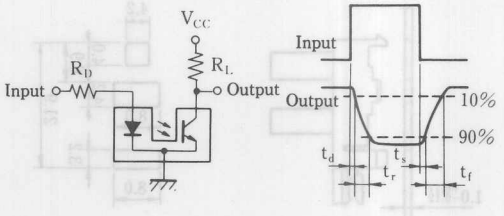


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

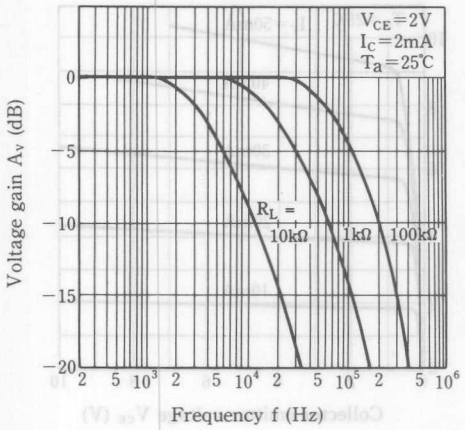


Fig. 11 Collector Dark Curent vs. Ambient Temperature

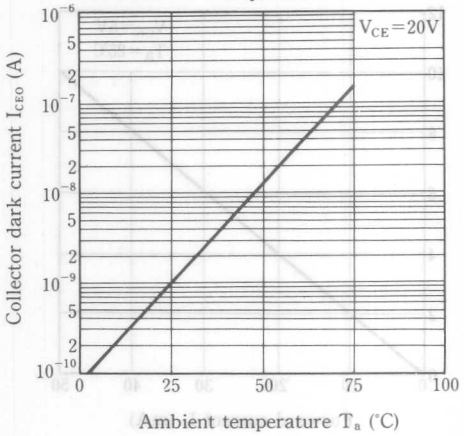


Fig. 12 Relative Collector Current vs. Shield Distance (1)

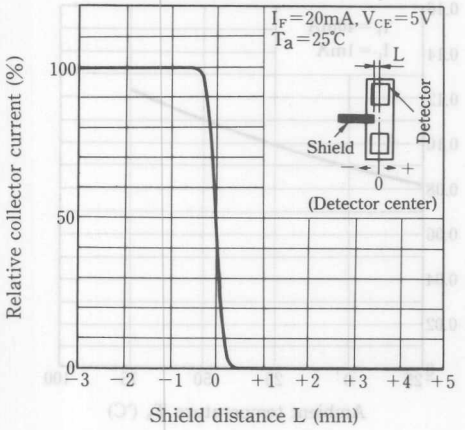
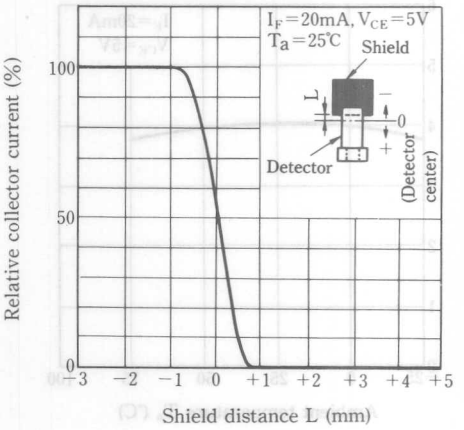
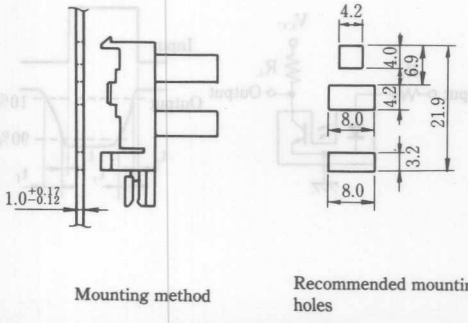
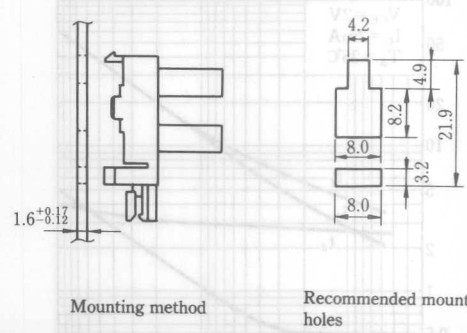


Fig. 13 Relative Collector Currennt vs. Shield Distance (2)



■ Recommended Mounting Holes





■ Precautions for Use

1) In this product, the PWB is fixed with a hook, and cleaning solvent may remain inside the case; therefore, dip cleaning or ultrasonic cleaning is prohibited.
2) Remove dust or stains, using an air blower or a soft cloth moistened in cleaning solvent. However, do not perform the above cleaning using a soft cloth with cleaning solvent in the marking portion.
   In this case, use only the following type of cleaning solvent used for wiping off:
   Ethyl alcohol, Methyl alcohol, Isopropyl alcohol,
   Freon TE, Freon TF, Diflon solvent S3-E

In circuit designing, make allowance for the degradation of the light emitting diode output that results from long continuous operation. (MAX.: 50% degradation/5 years)

7

GP1S10 Photointerrupter with Dust Cover

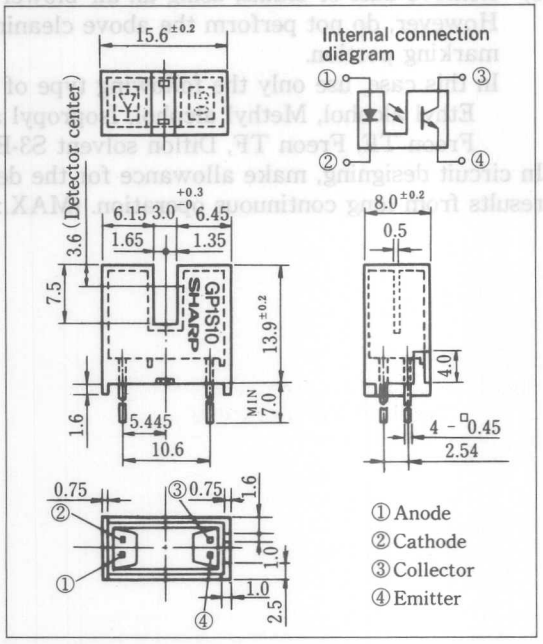
■ Features

1. With dust cover
2. High sensing accuracy (Slit width : 0.5mm)
3. PWB direct mounting type package

■ Applications

1. Copiers, printers, facsimiles
2. Ticket vending machines

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse Current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	2	—	75	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=0.2mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	3	15	μs
	Response time (Fall)	t_f	R_L=100Ω	—	4	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

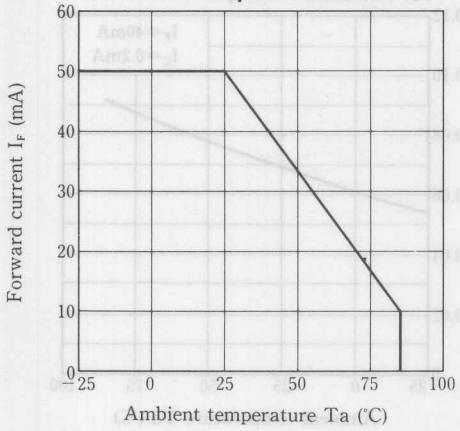


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

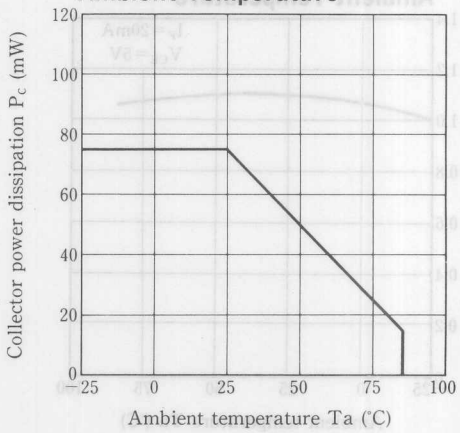


Fig. 3 Peak Forward Current vs. Duty Ratio

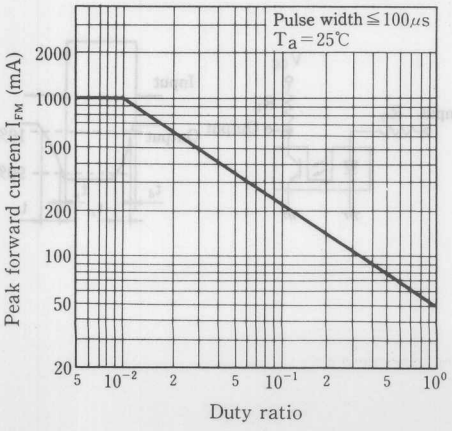
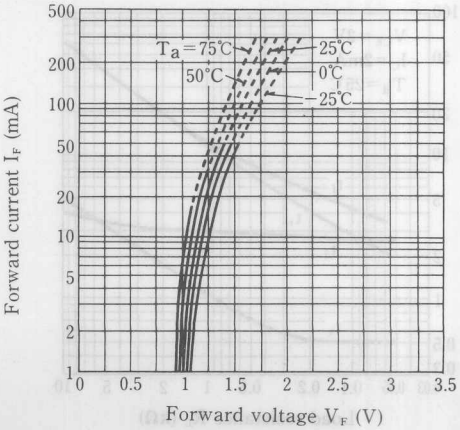


Fig. 4 Forward Current vs. Forward Voltage



7

Fig. 5 Collector Current vs. Forward Current

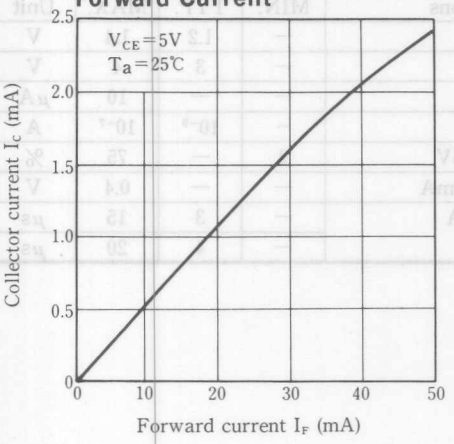


Fig. 6 Collector Current vs. Collector-emitter Voltage

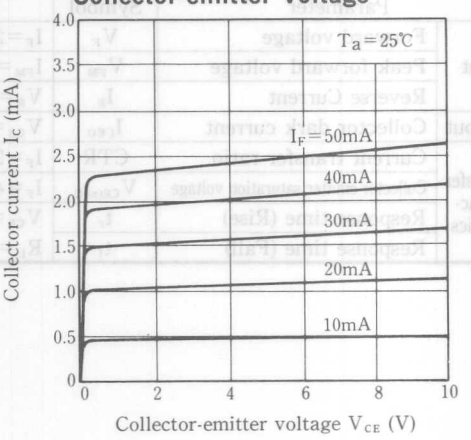


Fig. 7 Collector Current vs. Ambient Temperature

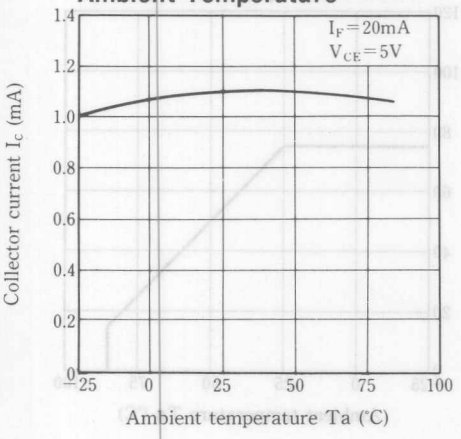


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

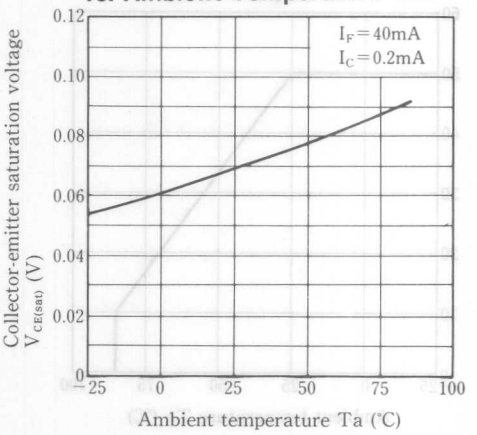
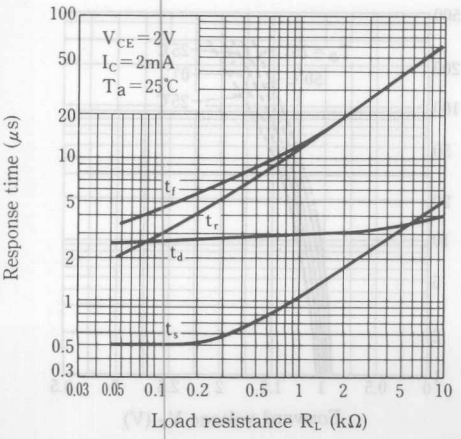


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

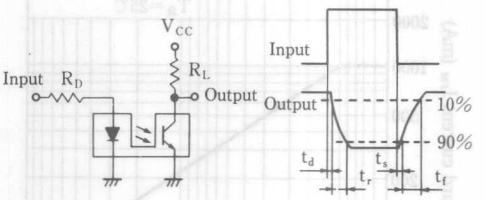


Fig. 10 Frequency Response

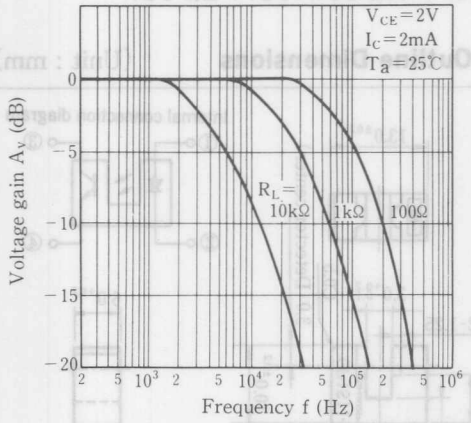


Fig. 11 Collector Dark Current vs. Ambient Temperature

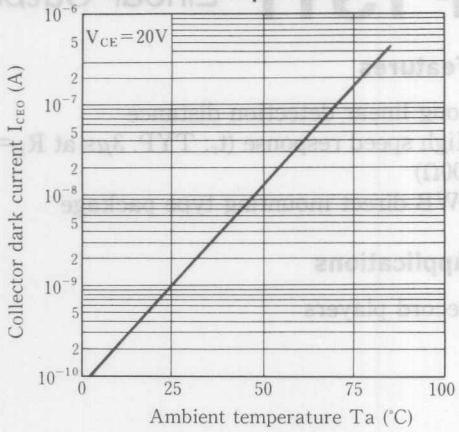


Fig. 12 Relative Collector Current vs. Shield Distance (1)

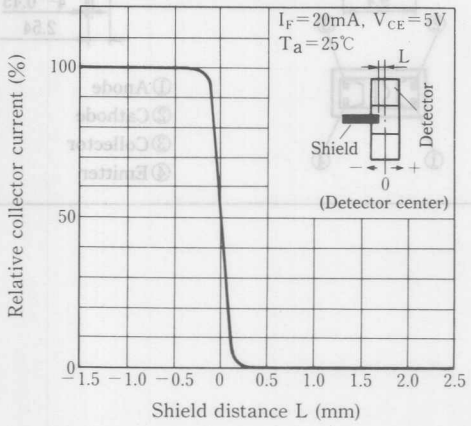
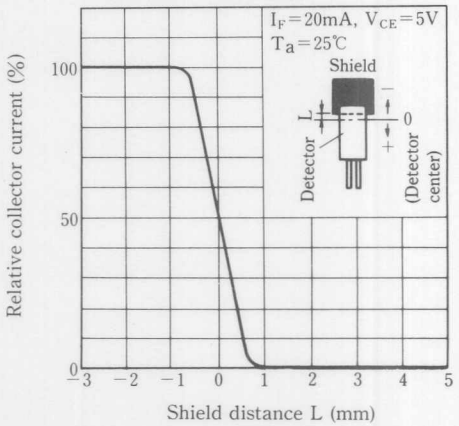


Fig. 13 Relative Collector Current vs. Shield Distance (2)



7

GP1S11 Linear Output Type Photointerrupter

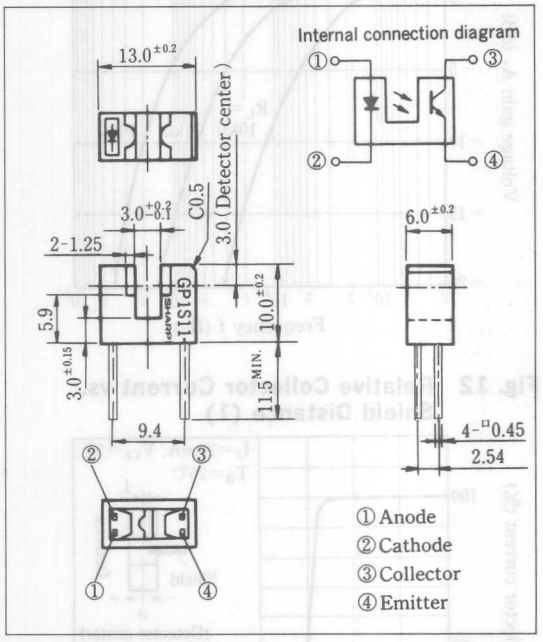
■ Features

1. Long linear detection distance
2. High speed response (t_r: TYP. 3μs at R_L = 100Ω)
3. PWB direct mounting type package

■ Applications

1. Record players

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	11.5	—	100	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=0.5mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA,	—	3	15	μs
	Response time (Fall)	t_f	R_L=100Ω	—	4	20	μs
	*3Linear distance		I_F=20mA, V_{CE}=5V	1.26	—	1.95	mm

*3 moving distance during collector current (I_C) changes 90% to 10% of the initial value.

(Note)

The housing is made of resin that cuts off visible light and transmits infrared light. Take into due consideration the effects that external disturbing lights might have on these characteristics when mounting as the output current will increase resulting in liner characteristics errors if a light containing long wavelength ingredient (such as sunlight or tungsten lamp light) enters as an external disturbing light.

Fig. 1 Forward Current vs. Ambient Temperature

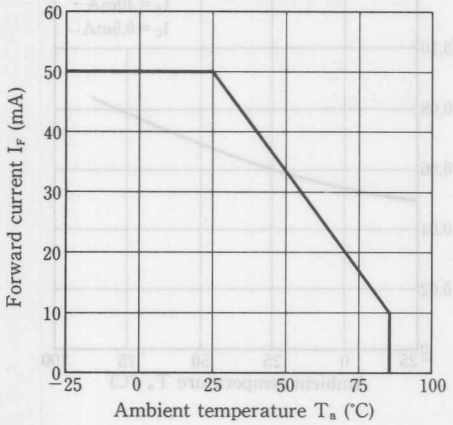


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

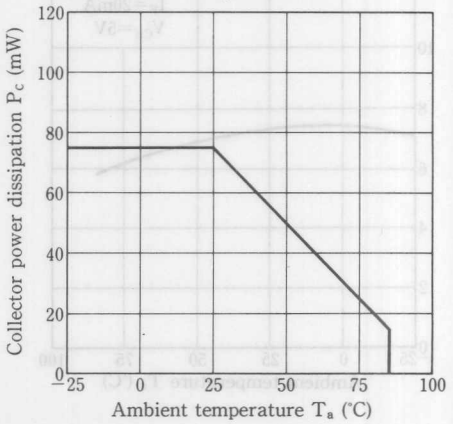


Fig. 3 Peak Forward Current vs. Duty Ratio

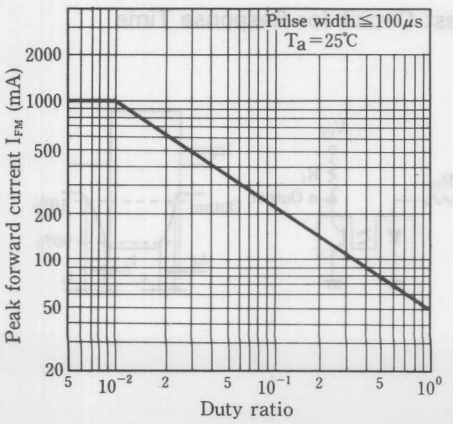
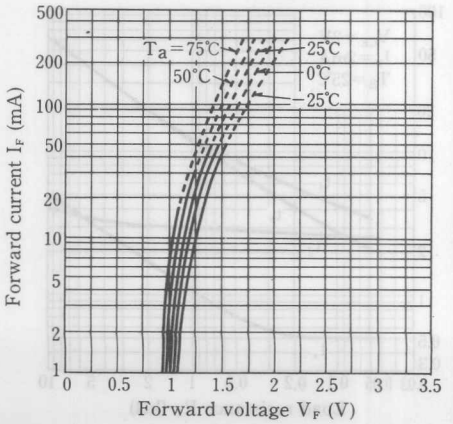


Fig. 4 Forward Current vs. Forward Voltage



7

Fig. 5 Collector Current vs. Forward Current

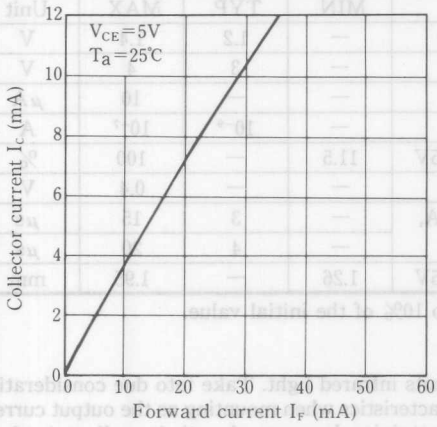


Fig. 6 Collector Current vs. Collector-emitter Voltage

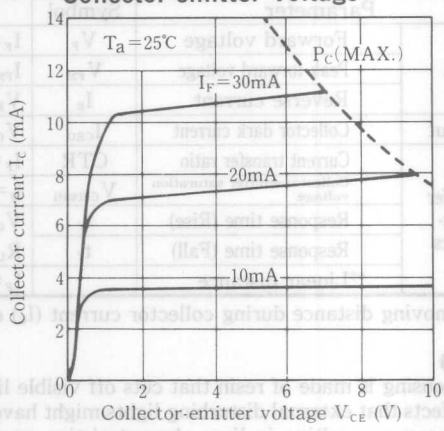


Fig. 7 Collector Current vs. Ambient Temperature

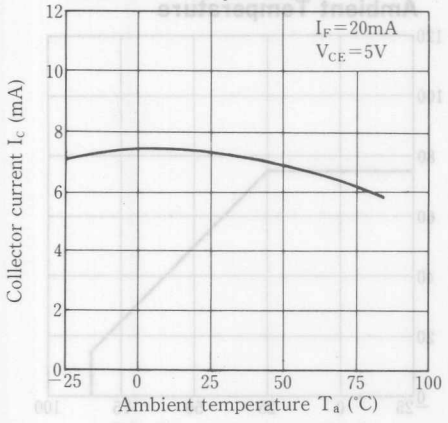


Fig.8 Collector-emitter Saturation Voltage vs. Ambient Temperature

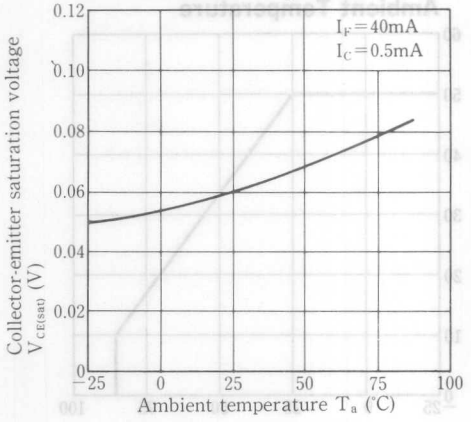
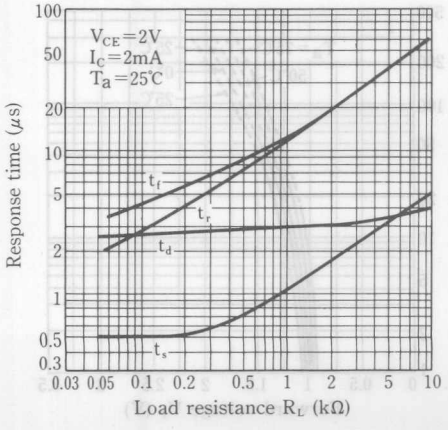


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

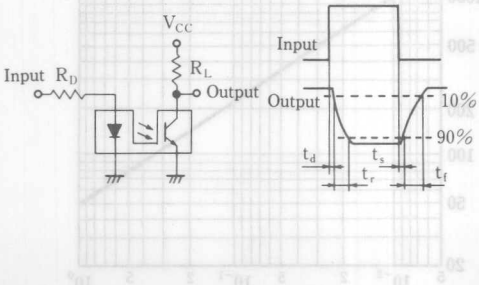


Fig. 10 Frequency Response

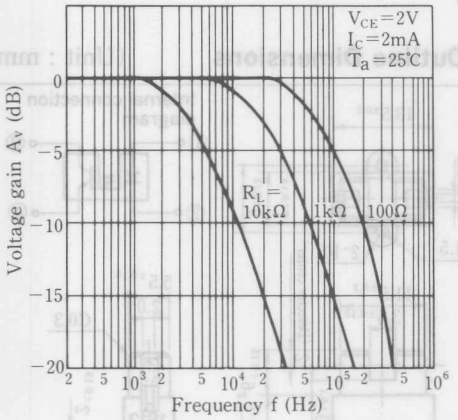


Fig. 11 Collector Dark Current vs. Ambient Temperature

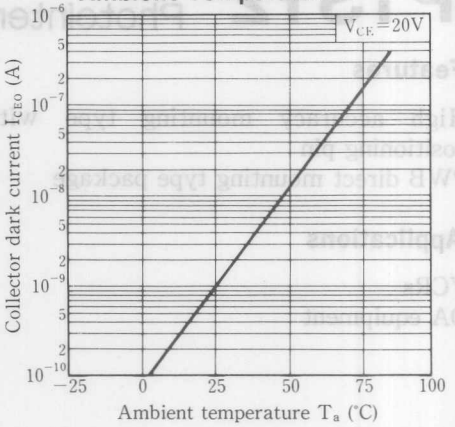


Fig. 12 Relative Collector Current vs. Shield Distance (1)

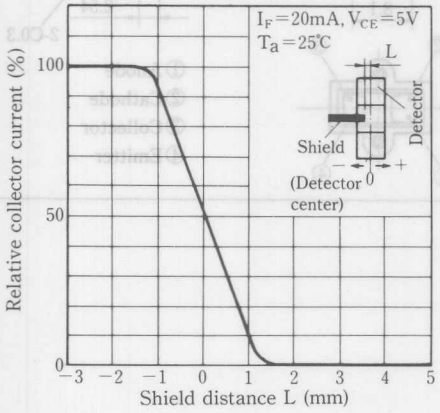
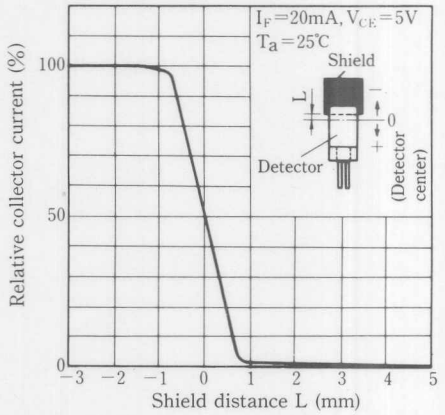


Fig. 13 Relative Collector Current vs. Shield Distance (2)



7

GP1S12 High Accuracy Mounting Type Photointerrupter

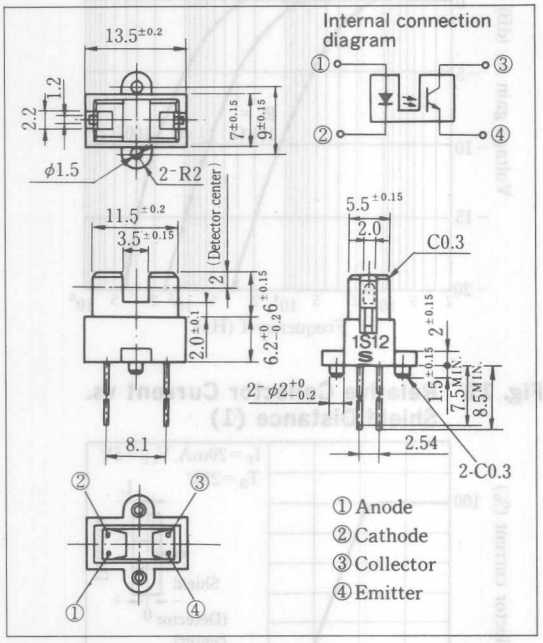
■ Features

1. High accuracy mounting type with positioning pin
2. PWB direct mounting type package

■ Applications

1. VCRs
2. OA equipment

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collectot voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=10mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=10mA, V_{CE}=5V	10	—	150	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=1mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	3	15	μs
	Response time (Fall)	t_f	R_L=100Ω	—	4	20	μs

(Precautions for Use)

It should be taken into consideration in your application that vibrations may cause the collector current to vary in the range of up to 20% due to its structural design.

Fig. 1 Forward Current vs. Ambient Temperature

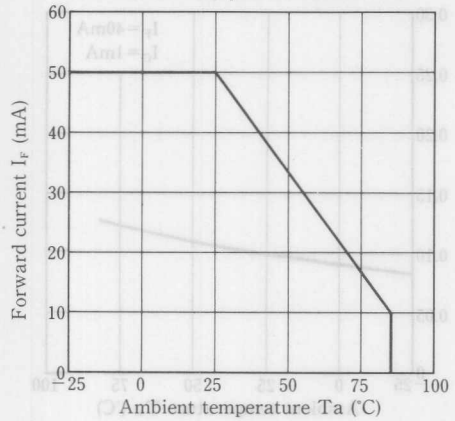


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

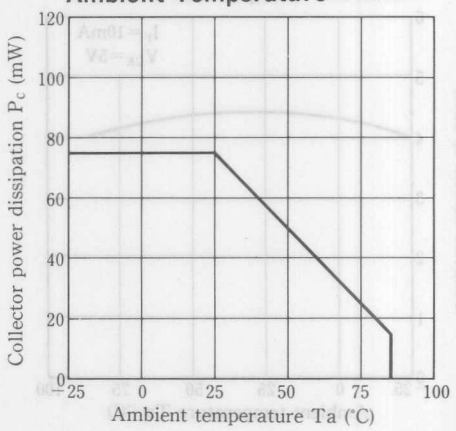


Fig.3 Peak Forward Current vs. Duty Ratio

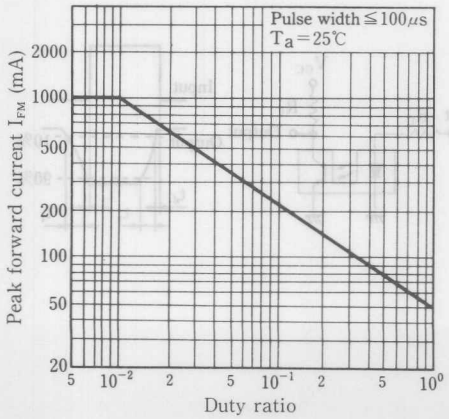
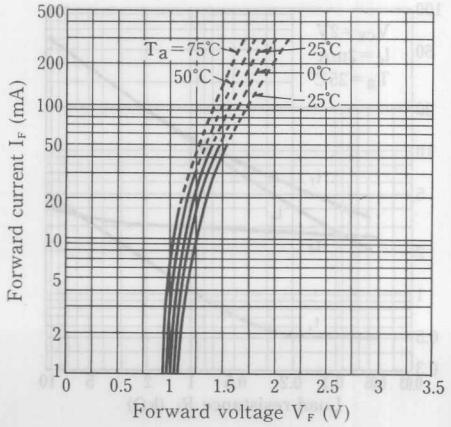


Fig. 4 Forward Current vs. Forward Voltage



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Fig. 5 Collector Current vs. Forward Current

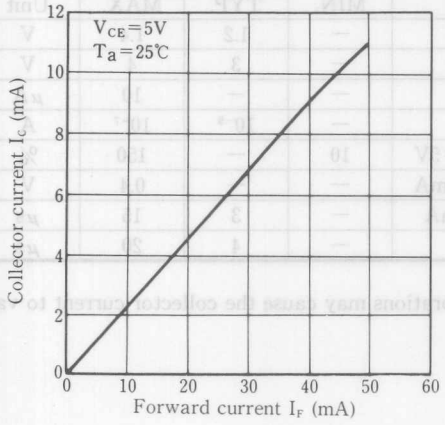


Fig. 6 Collector Current vs. Collector-emitter Voltage

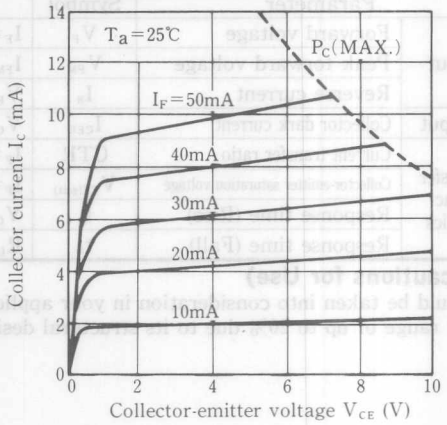


Fig. 7 Collector Current vs. Ambient Temperature

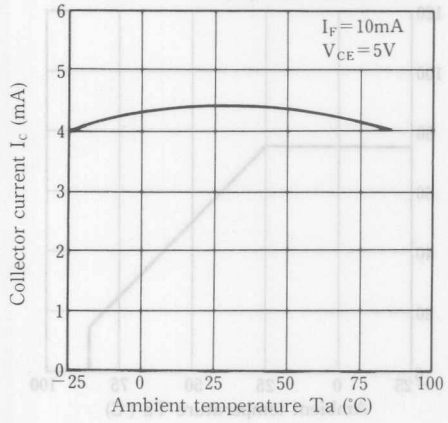


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

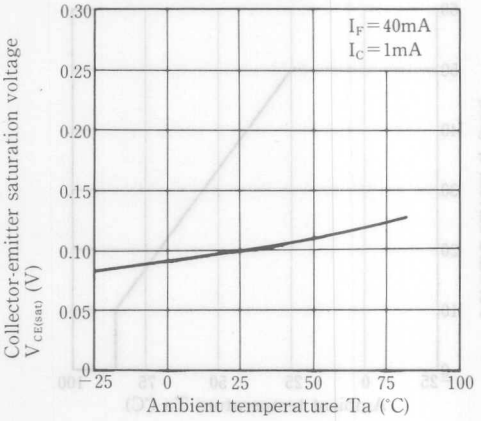
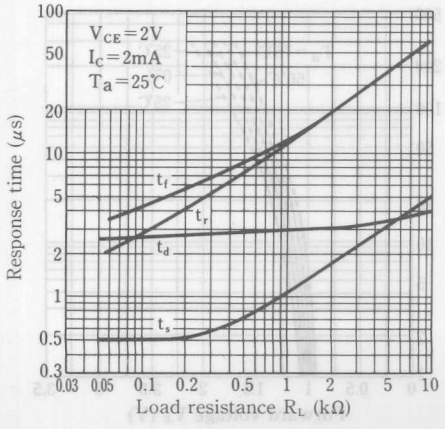


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

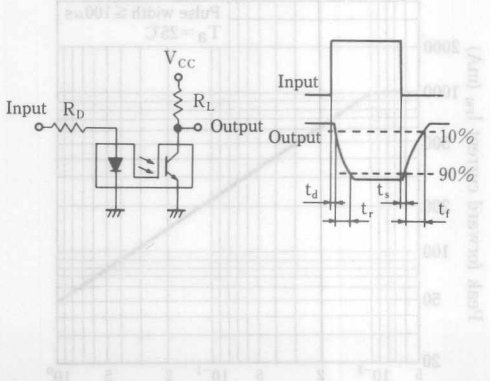


Fig. 10 Frequency Response

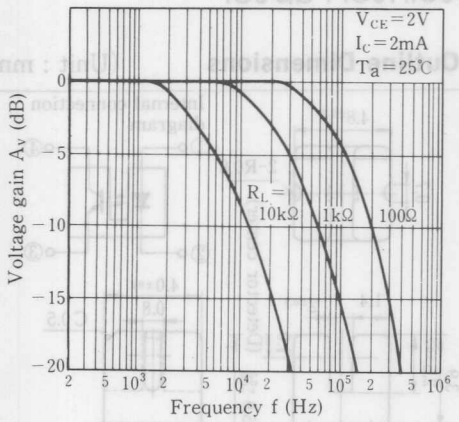


Fig. 11 Collector Dark Current vs. Ambient Temperature

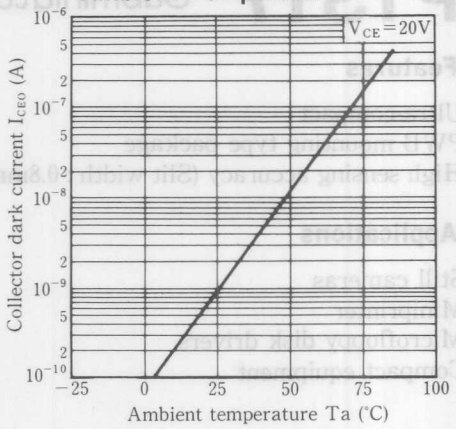


Fig. 12 Relative Collector Current vs. Shield Distance (1)

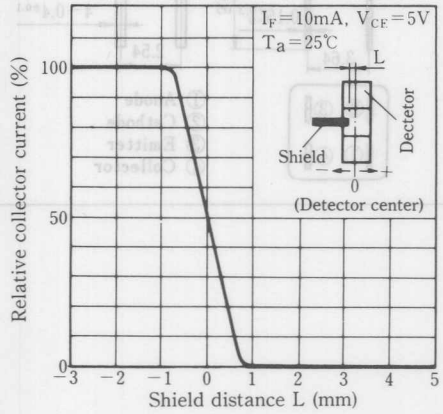
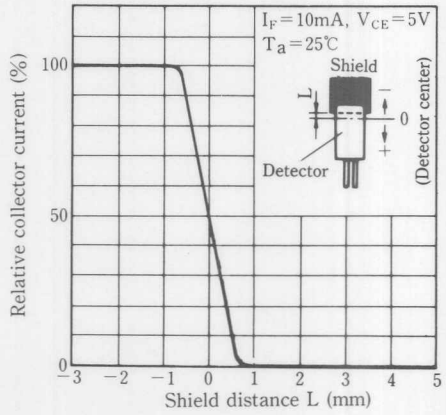


Fig. 13 Relative Collector Current vs. Shield Distance (2)



7

GP1S17 Subminiature Photointerrupter

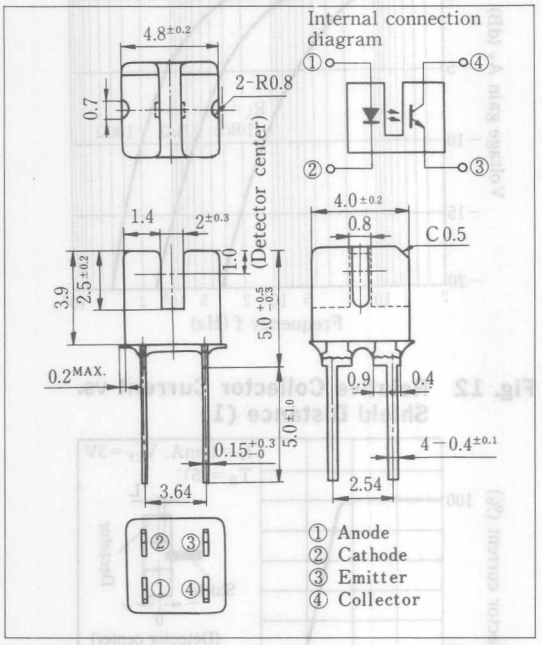
■ Features

1. Ultra-compact
2. PWB mounting type package
3. High sensing accuracy (Slit width : 0.8mm)

■ Applications

1. Still cameras
2. Miniprinter
3. Microfloppy disk drivers
4. Compact equipment

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 3 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=6mA, V_{CE}=5V	1	—	10	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=3mA, I_C=15μA	—	0.08	0.4	V
	Response time (Rise)	t_r	I_C=0.1mA, V_{CE}=5V, R_L=1kΩ	—	50	150	μs
	Response time (Fall)	t_f		—	50	150	μs

Fig. 1 Forward Current vs. Ambient Temperature

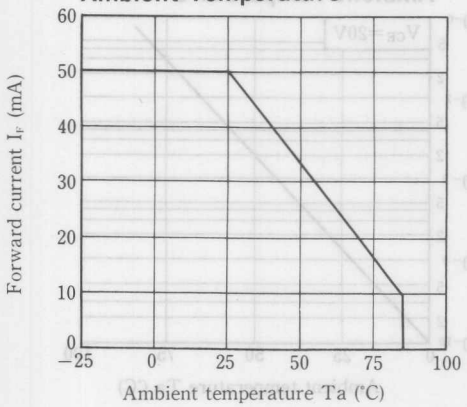


Fig. 2 Power Dissipation vs. Ambient Temperature

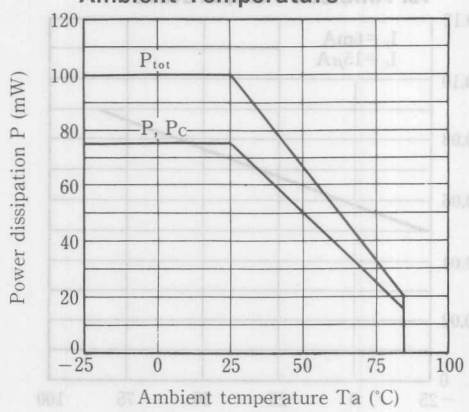


Fig. 3 Forward Current vs. Forward Voltage

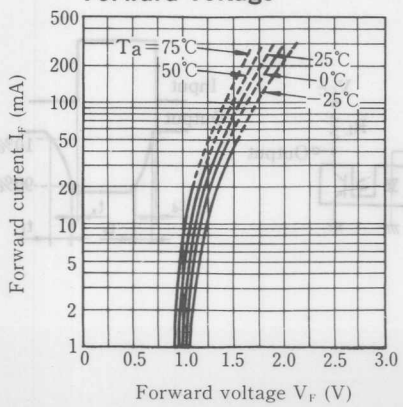
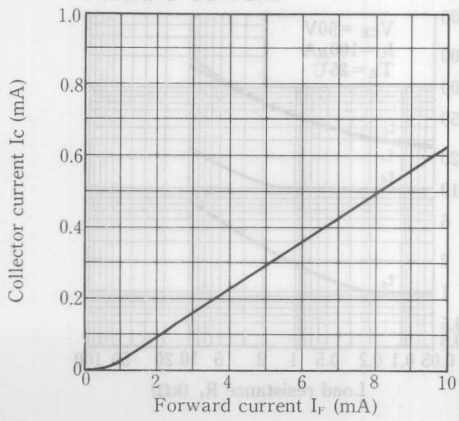


Fig. 4 Collector Current vs. Forward Current



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Fig. 5 Collector Current vs. Collector-emitter Voltage

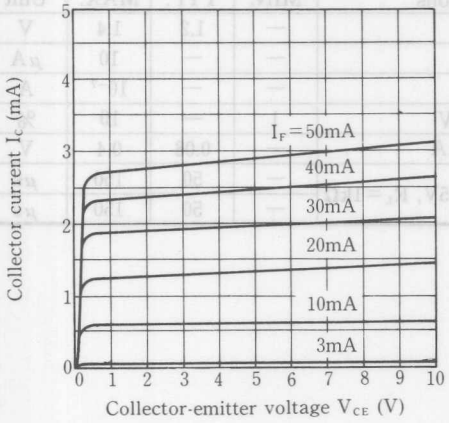


Fig. 6 Collector Current vs. Ambient Temperature

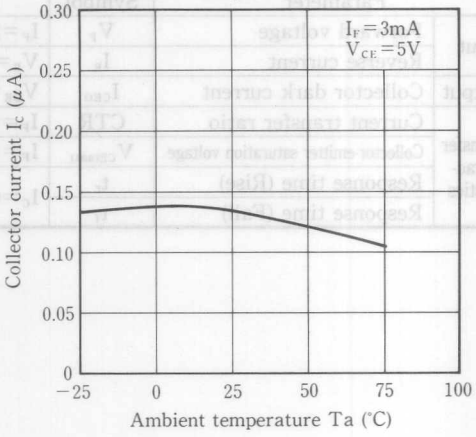


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

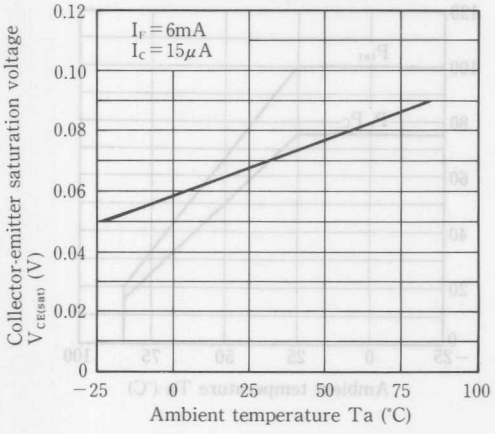


Fig. 8 Collector Dark Current vs. Ambient Temperature

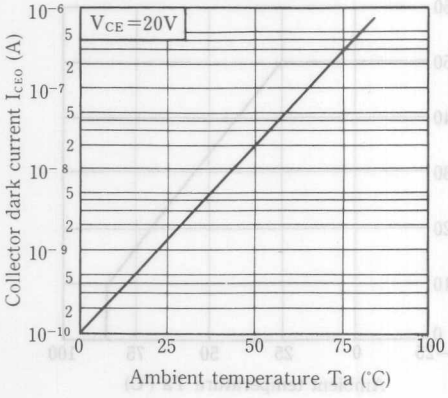
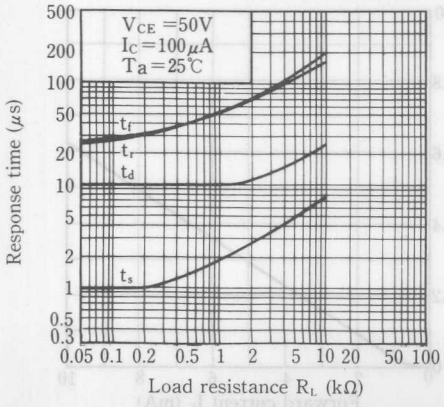


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

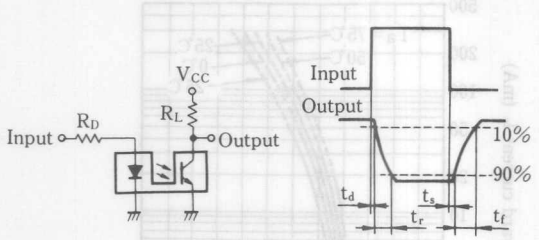


Fig. 10 Relative Collector Current vs. Shield Distance (1)

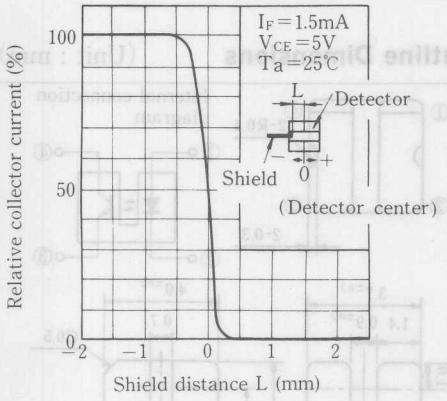
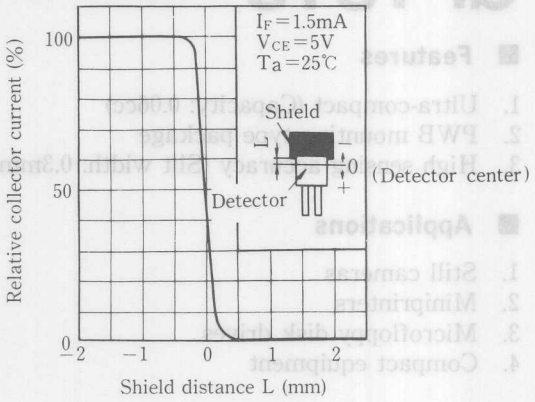


Fig. 11 Relative Collector Current vs. Shield Distance (2)



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GP1S18 Subminiature Photointerrupter

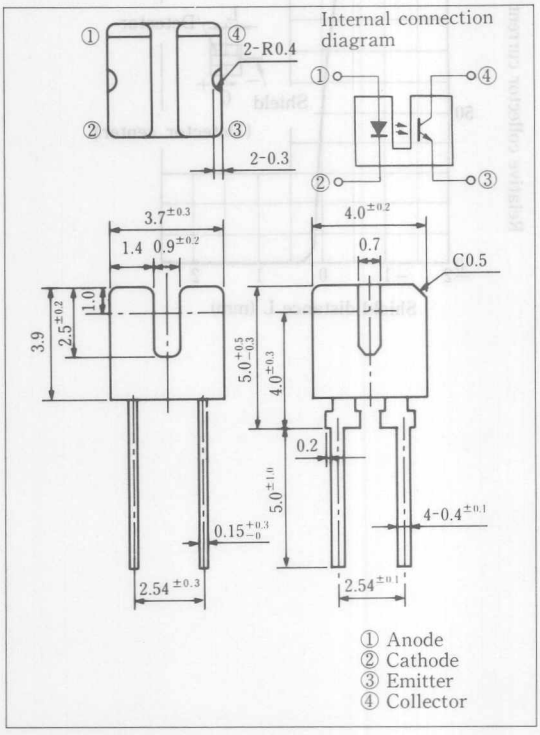
■ Features

1. Ultra-compact (Capacity: 0.06cc)
2. PWB mounting type package
3. High sensing accuracy (Slit width: 0.3mm)

■ Applications

1. Still cameras
2. Miniprinters
3. Microfloppy disk drives
4. Compact equipment

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	—	10^{-7}	A
Transfer charec-teristics	Current transfer ratio	CTR	I_F=1.5mA, V_{CE}=5V	1.6	—	16	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=3mA, I_C=15μA	—	0.07	0.4	V
	Response time (Rise)	t_r	I_C=0.1mA, V_{CE}=5V, R_L=1kΩ	—	50	150	μs
	Response time (Fall)	t_f		—	50	150	μs

Fig. 1 Forward Current vs. Ambient Temperature

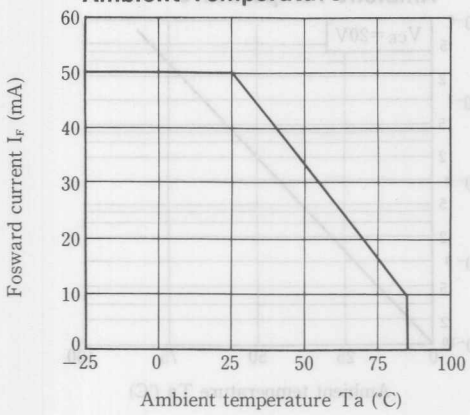


Fig. 2 Power Dissipation vs. Ambient Temperature

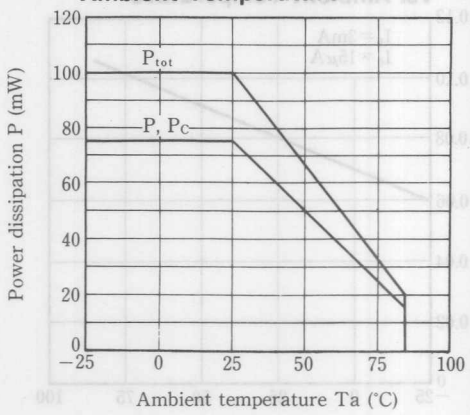


Fig. 3 Forward Current vs. Forward Voltage

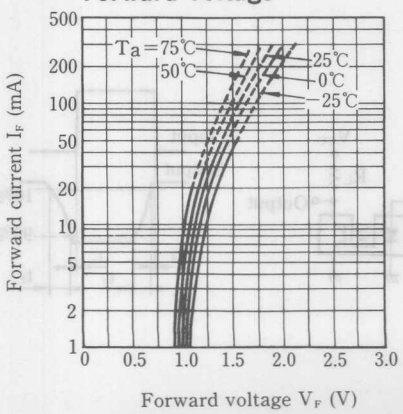
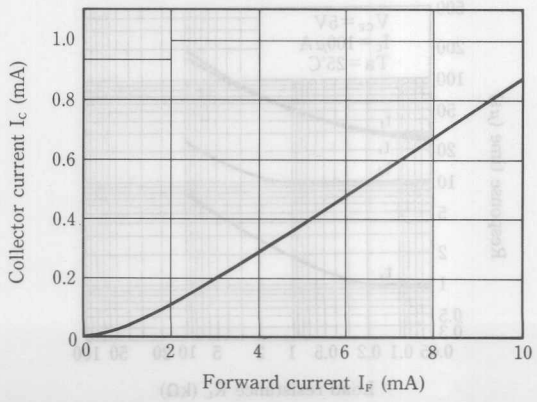


Fig. 4 Collector Current vs. Forward Current



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Fig. 5 Collector Current vs. Collector-emitter Voltage

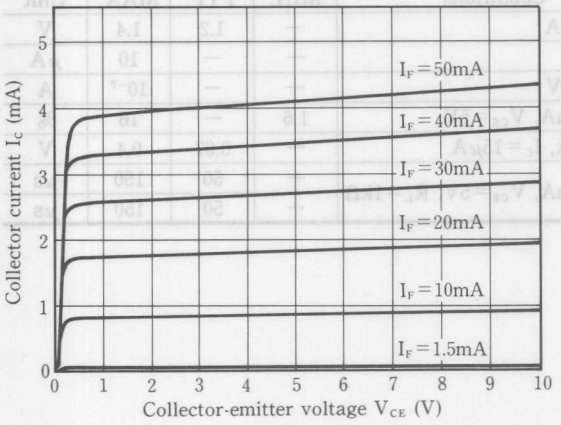


Fig. 6 Collector Current vs. Ambient Temperature

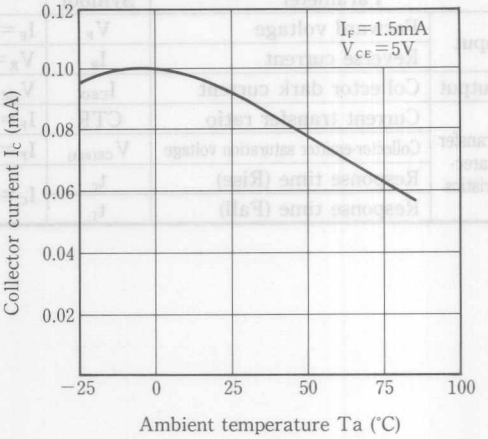


Fig. 7 Collector-emitter Saturation Voltage Vs. Ambient Temperature

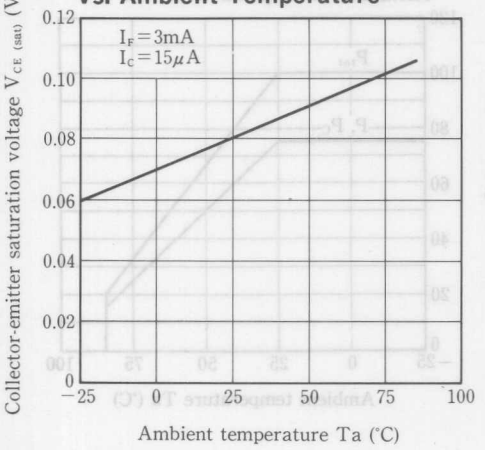


Fig. 8 Collector Dark Current vs. Ambient Temperature

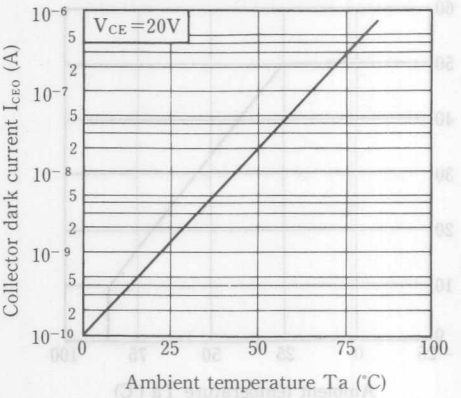
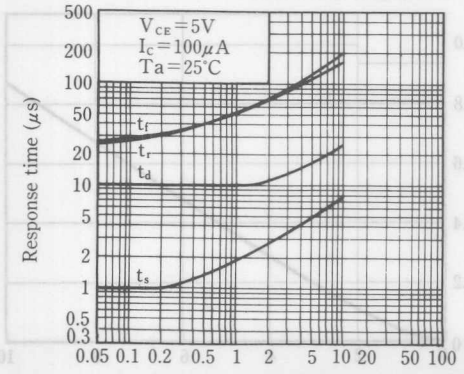


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

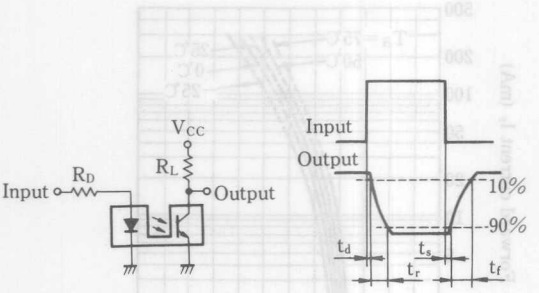


Fig. 10 Relative Collector Current vs. Shield Distance (1)

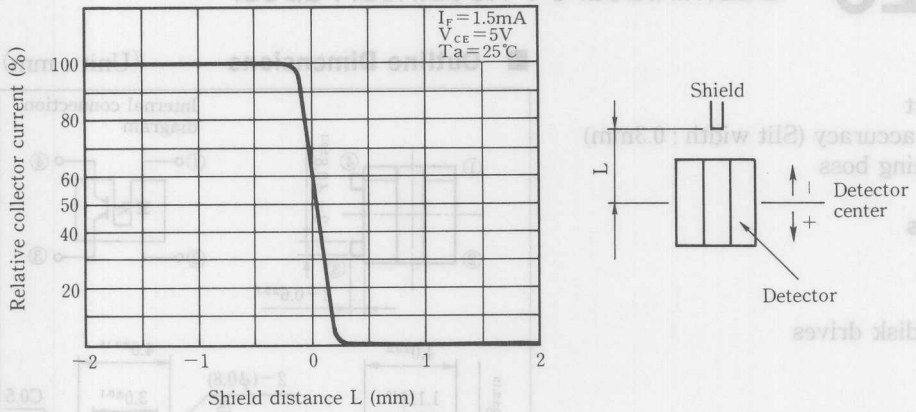
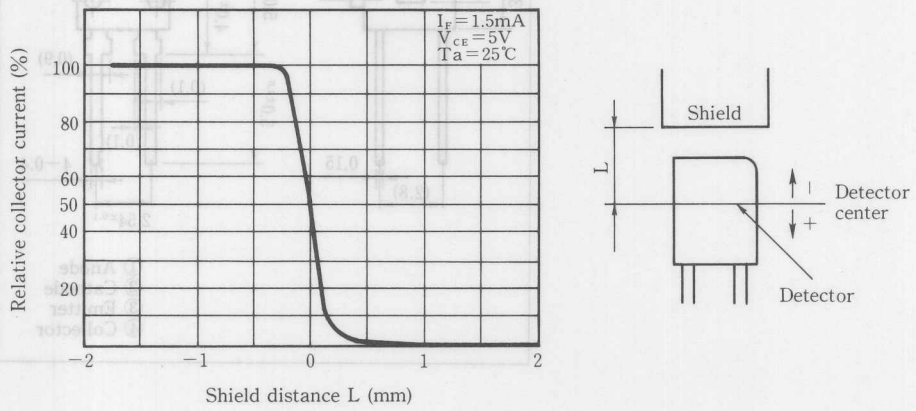


Fig. 11 Relative Collector Current vs. Shield Distance (2)



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GP1S20 Subminiature Photointerrupter

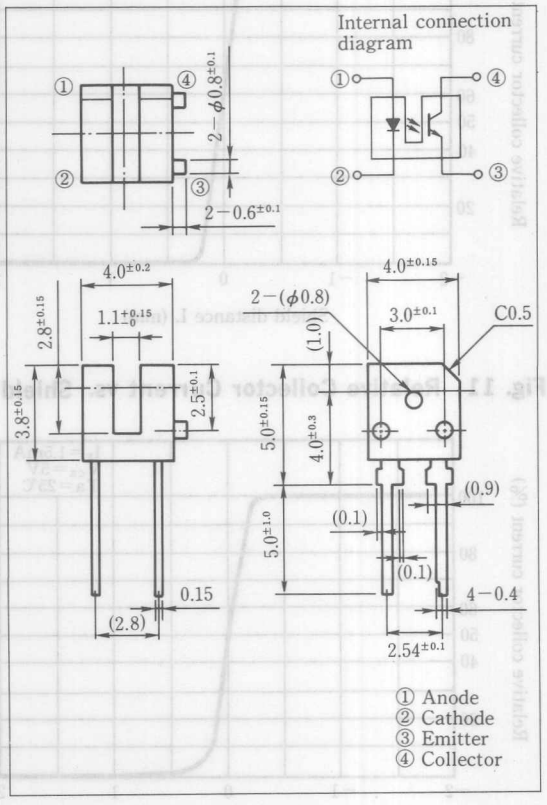
■ Features

1. Ultra-compact
2. High sensing accuracy (Slit width : 0.3mm)
3. With positioning boss

■ Applications

1. Still cameras
2. Miniprinters
3. Microfloppy disk drives

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	—	10^{-7}	A
Transfer charec-teristics	Current transfer ratio	CTR	I_F=1.5mA, V_{CE}=5V	1.6	—	16	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=3mA, I_C=15μA	—	0.07	0.4	V
	Response time (Rise)	t_r	I_C=0.1mA, V_{CE}=5V, R_L=1kΩ	—	50	150	μs
	Response time (Fall)	t_f		—	50	150	μs

Fig. 1 Forward Current vs. Ambient Temperature

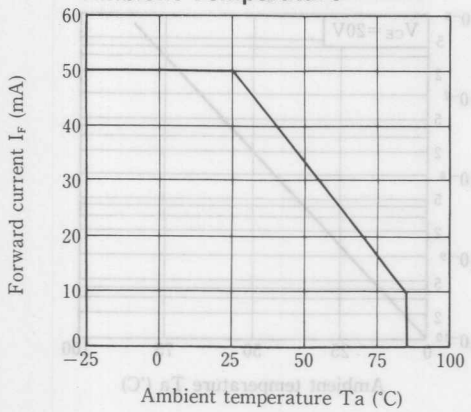


Fig. 2 Power Dissipation vs. Ambient Temperature

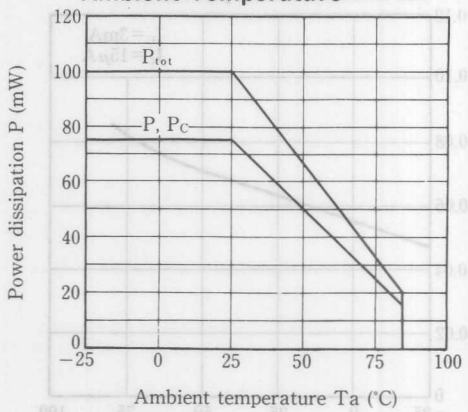


Fig. 3 Forward Current vs. Forward Voltage

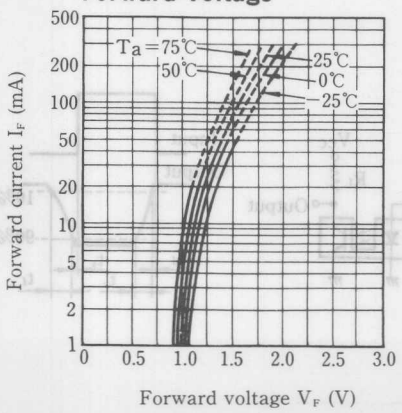
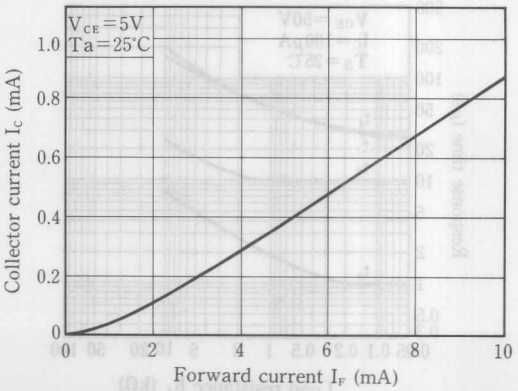


Fig. 4 Collector Current vs. Forward Current



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Fig. 5 Collector Current vs. Collector-emitter Voltage

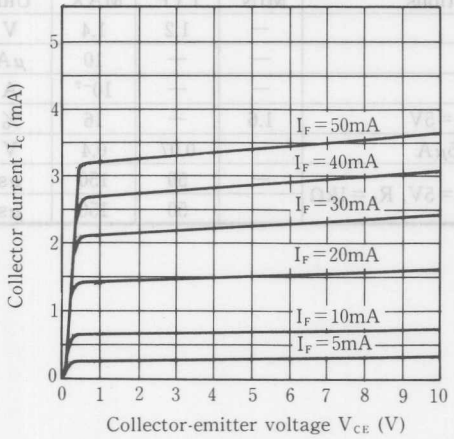


Fig. 6 Relative Collector Current vs. Ambient Temperature

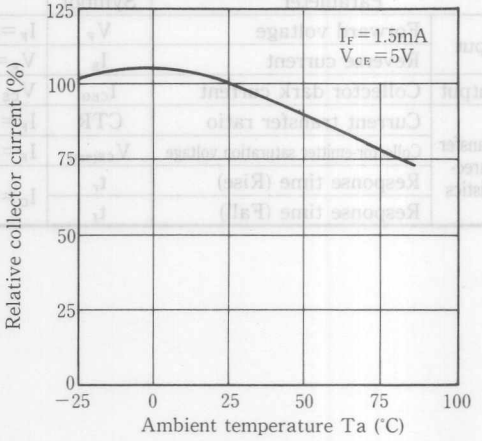


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

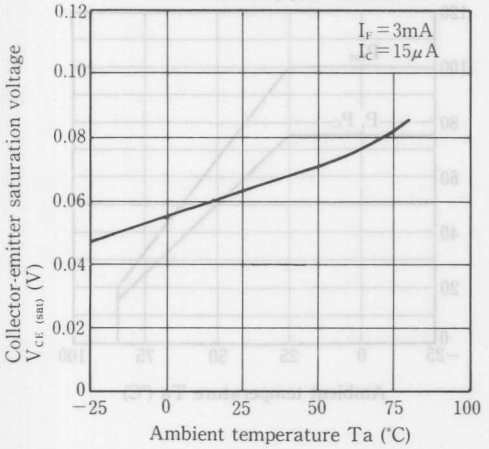


Fig. 8 Collector Dark Current vs. Ambient Temperature

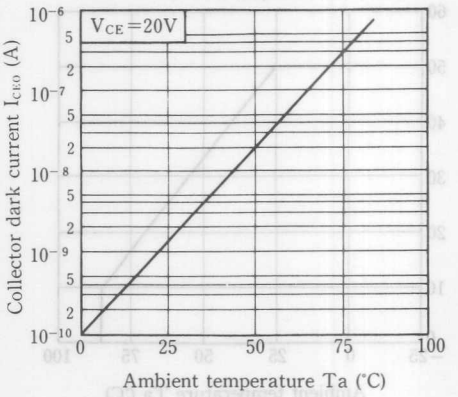
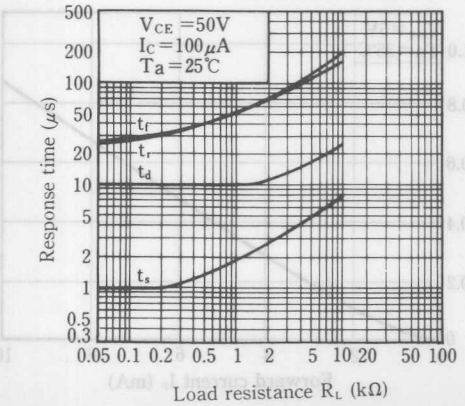


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

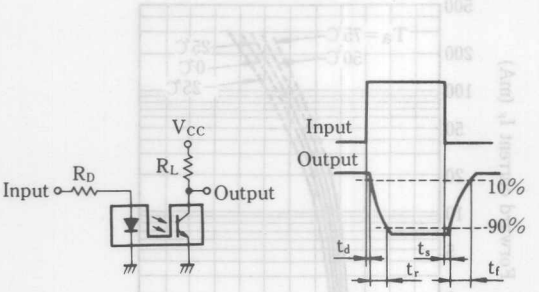
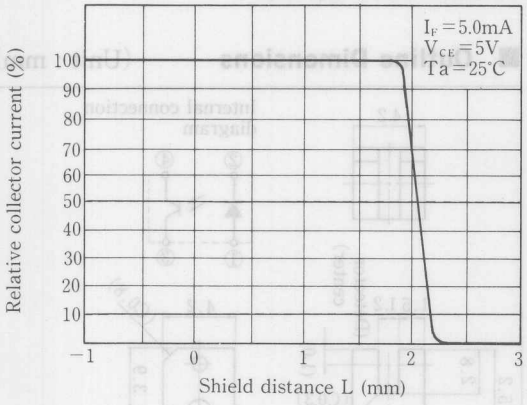


Fig. 10 Relative Collector Current vs. Shield Distance (1)



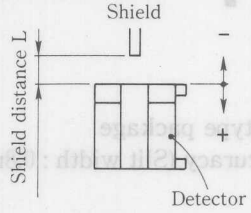
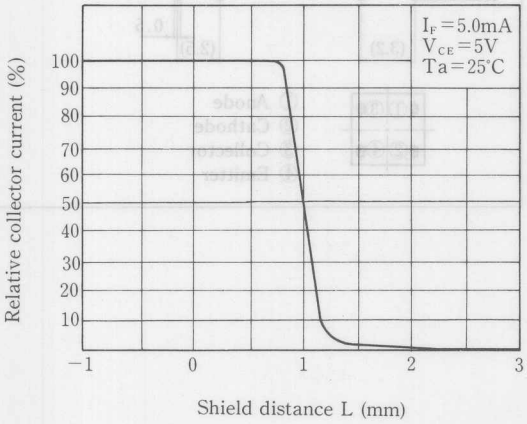
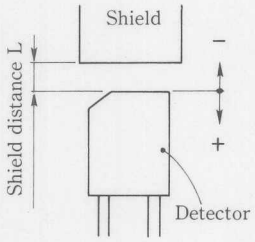


Fig. 11 Relative Collector Current vs. Shield Distance (2)





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GP1S21 Subminiature Photointerrupter

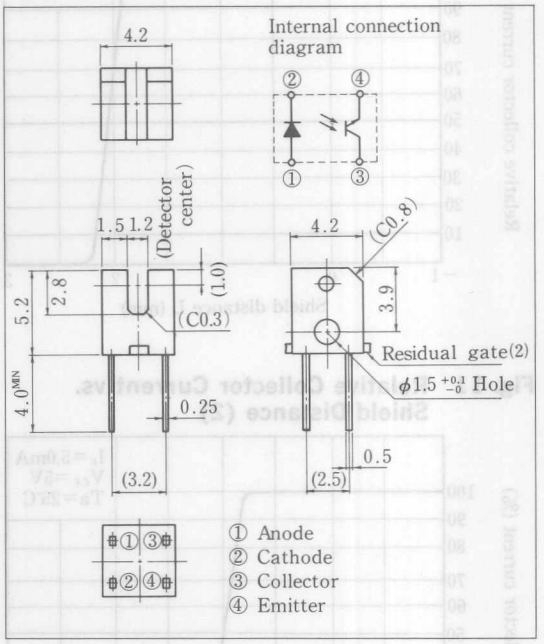
■ Features

1. Ultra-compact
2. PWB mounting type package
3. High sensing accuracy (Slit width : 0.8mm)

■ Applications

1. Still cameras
2. Miniprinters
3. Microfloppy disk drives
4. Compact equipment

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 3 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1.5mA, V_{CE}=5V	1.8	—	17.3	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=3mA, I_C=27μA	—	—	0.4	V
	Response time (Rise)	t_r	I_C=0.1mA, V_{CE}=5V, R_L=1kΩ	—	50	150	μs
	Response time (Fall)	t_f		—	50	150	μs

Fig. 1 Forward Current vs. Ambient Temperature

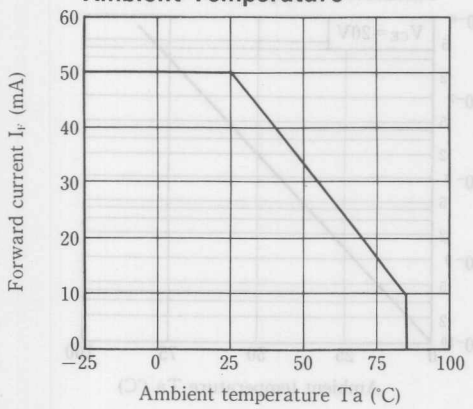


Fig. 2 Power Dissipation vs. Ambient Temperature

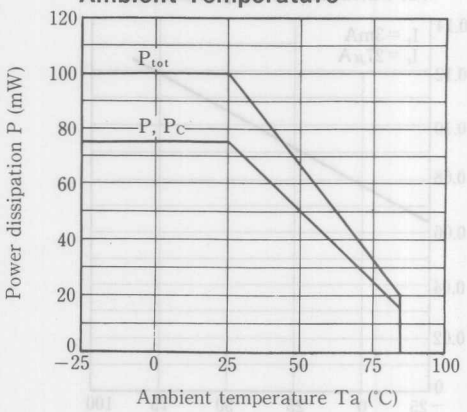


Fig. 3 Forward Current vs. Forward Voltage

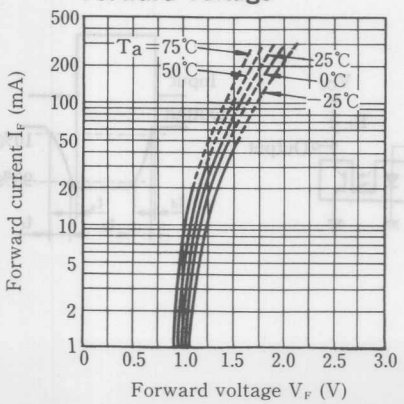
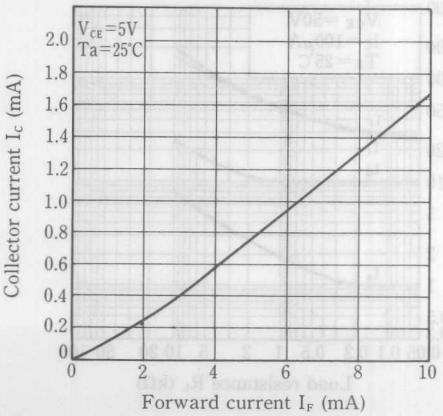


Fig. 4 Collector Current vs. Forward Current



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Fig. 5 Collector Current vs. Collector-emitter Voltage

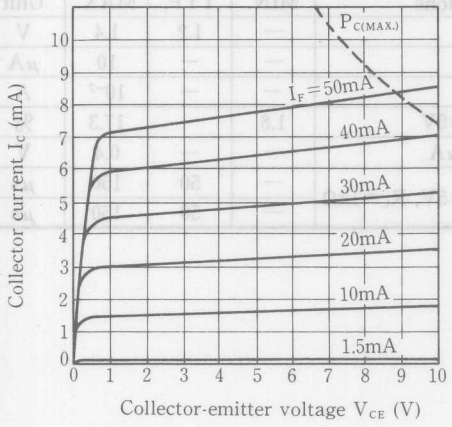


Fig. 6 Collector Current vs. Ambient Temperature

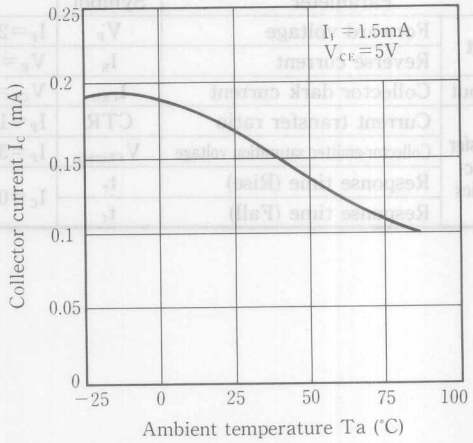


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

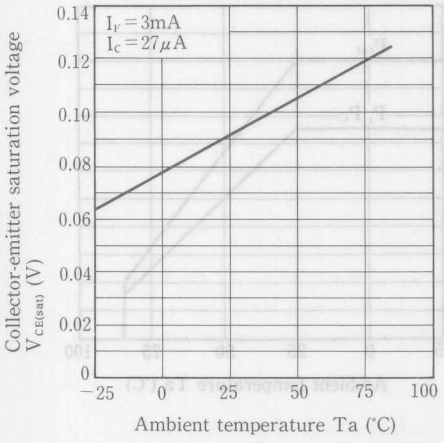


Fig. 8 Collector Dark Current vs. Ambient Temperature

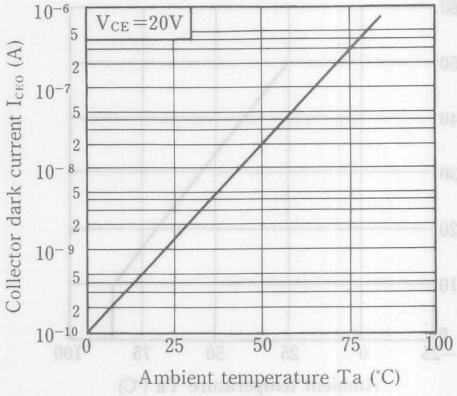
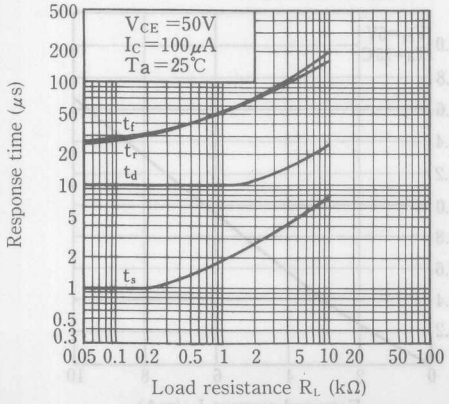


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

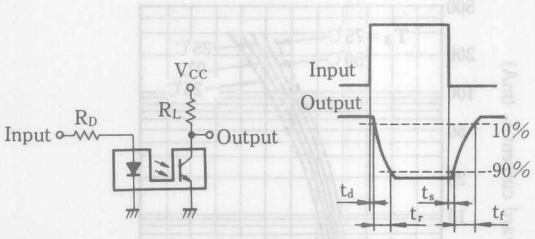
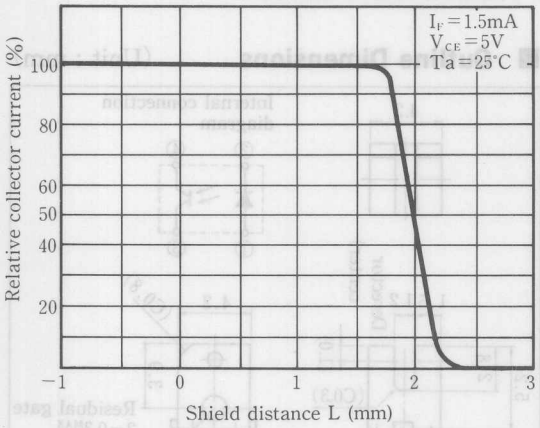


Fig. 10 Relative Collector current vs. Shield Distance (1)



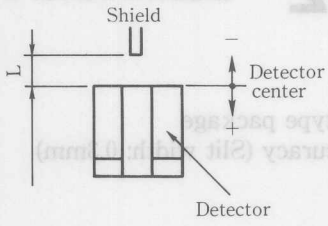
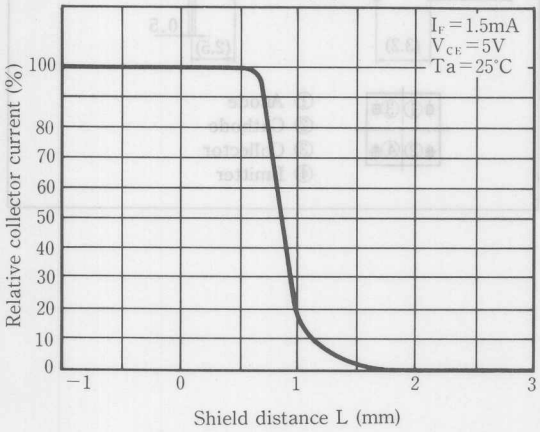
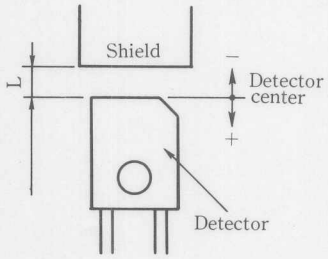


Fig. 11 Relative Collector current vs. Shield Distance (2)





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GP1S22 Subminiature Photointerrupter

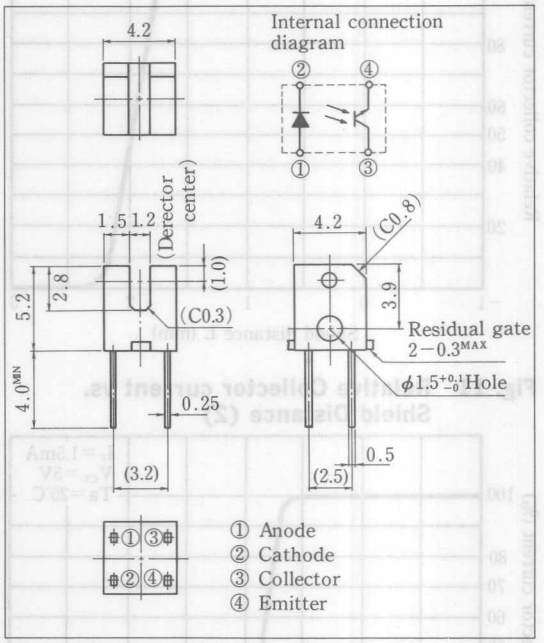
■ Features

1. Ultra-compact
2. PWB mounting type package
3. High sensing accuracy (Slit width: 0.3mm)

■ Applications

1. Still cameras
2. Miniprinters
3. Microfloppy disk drives
4. Compact equipment

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	2.0	—	26	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=10mA, I_C=50μA	—	—	0.4	V
	Response time (Rise)	t_r	I_C=0.1mA, V_{CE}=5V, R_L=1kΩ	—	50	150	μs
	Response time (Fall)	t_f		—	50	150	μs

Fig. 1 Forward Current vs. Ambient Temperature

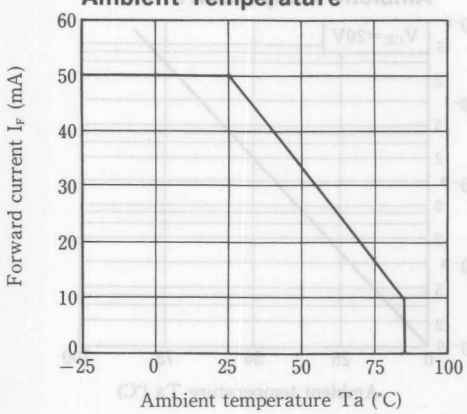


Fig. 2 Power Dissipation vs. Ambient Temperature

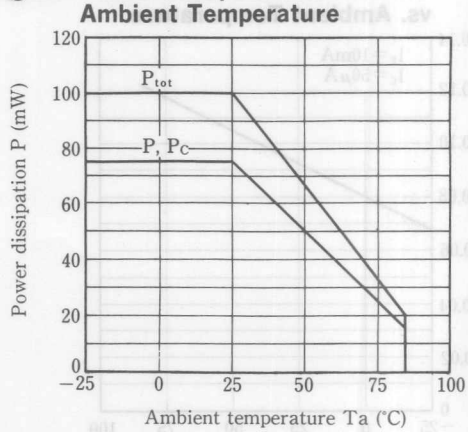


Fig. 3 Forward Current vs. Forward Voltage

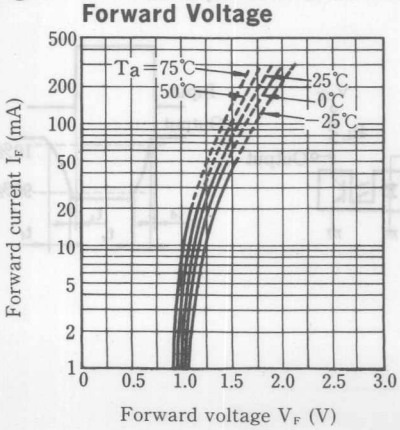
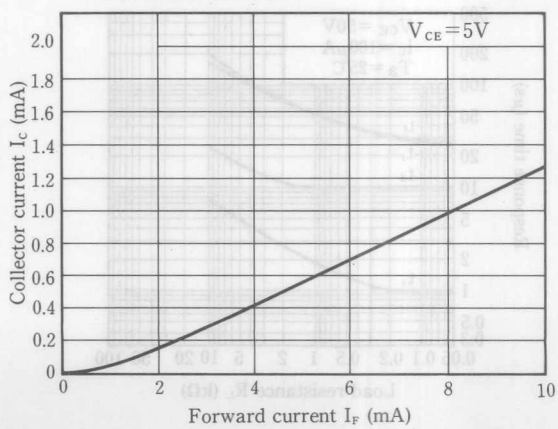


Fig. 4 Collector Current vs. Forward Current



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Fig. 5 Collector Current vs. Collector-emitter Voltage

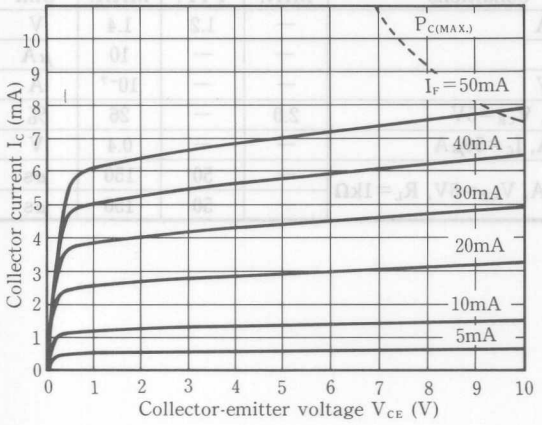


Fig. 6 Collector Current vs. Ambient Temperature

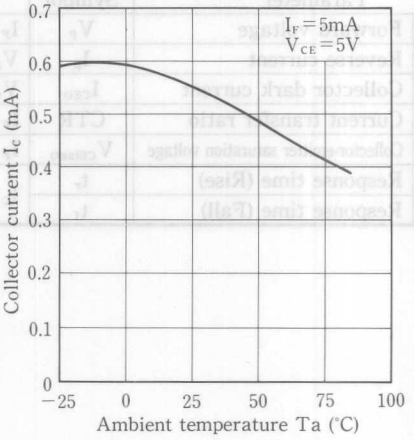


Fig. 7 Collector-emitter Saturation voltage vs. Ambient Temperature

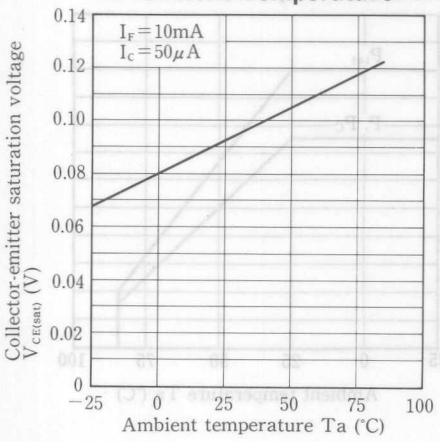


Fig. 8 Collector Dark Current vs. Ambient Temperature

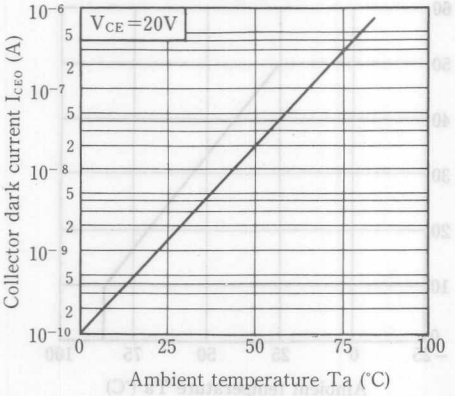
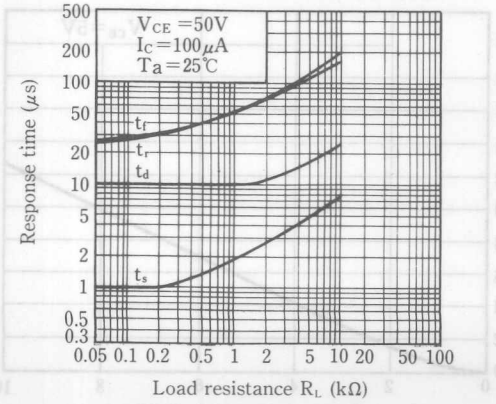


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

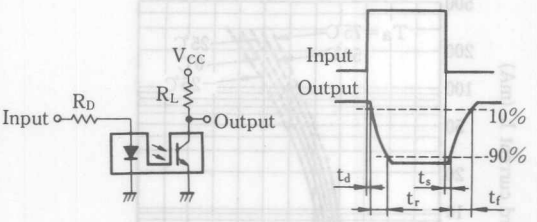
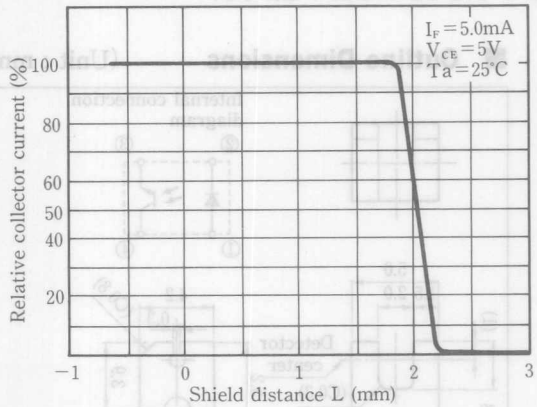


Fig. 10 Relative Collector Current vs. Shield Distance (1)



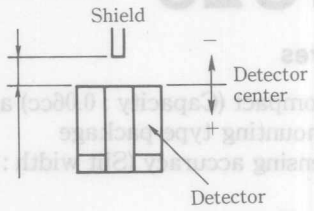
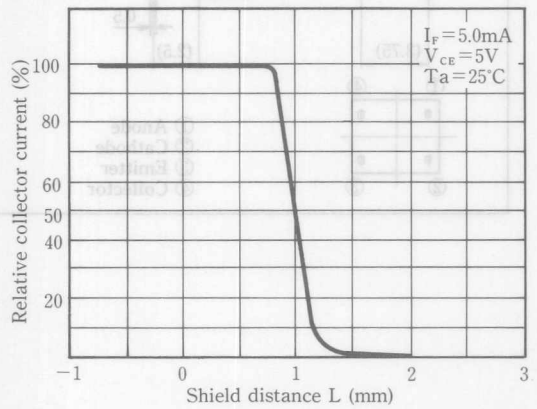
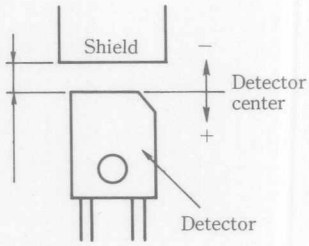


Fig. 11 Relative Collector Current vs. Shield Distance (2)





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GP1S23 Subminiature Photointerrupter

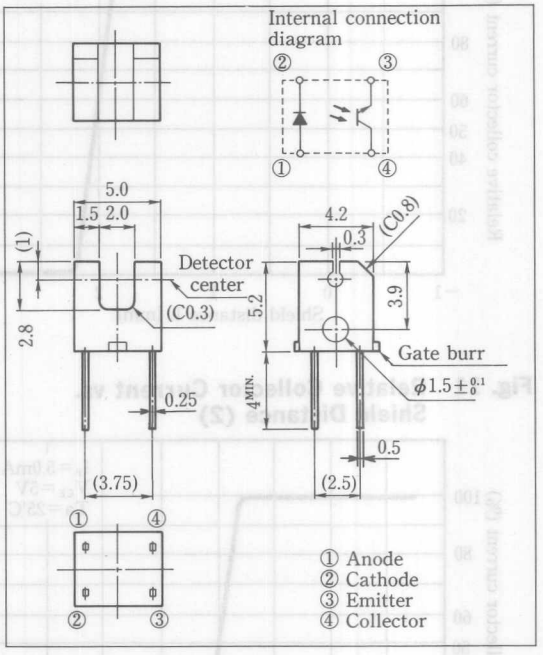
■ Features

1. Ultra-compact (Capacity : 0.06cc) and light
2. PWB mounting type package
3. High sensing accuracy (Slit width : 0.3mm)

■ Applications

1. Compact disk players

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 3 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=5mA, V_{CE}=5V	0.8	—	8	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=10mA, I_C=40μA	—	—	0.4	V
	Response time (Rise)	t_r	I_C=0.1mA, V_{CE}=5V, R_L=1kΩ	—	50	150	μs
	Response time (Fall)	t_f		—	50	150	μs

Fig. 1 Forward Current vs. Ambient Temperature

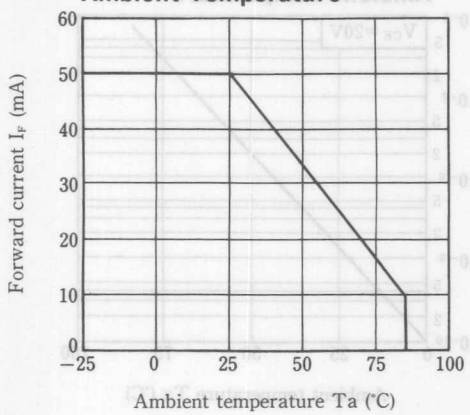


Fig. 2 Power Dissipation vs. Ambient Temperature

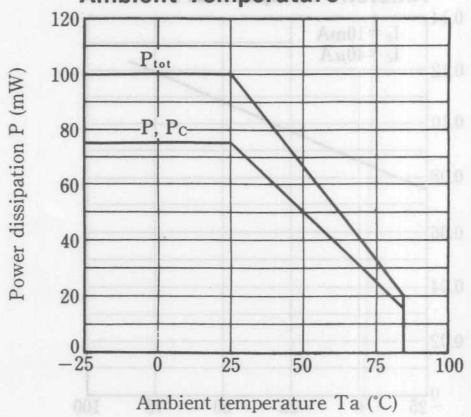


Fig. 3 Forward Current vs. Forward Voltage

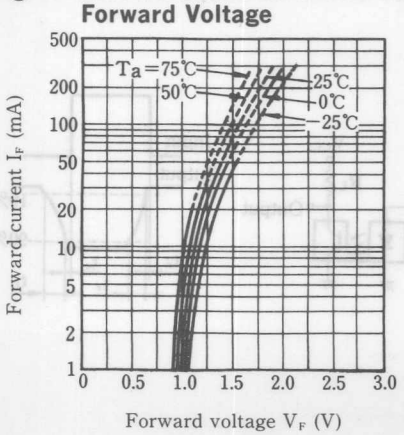
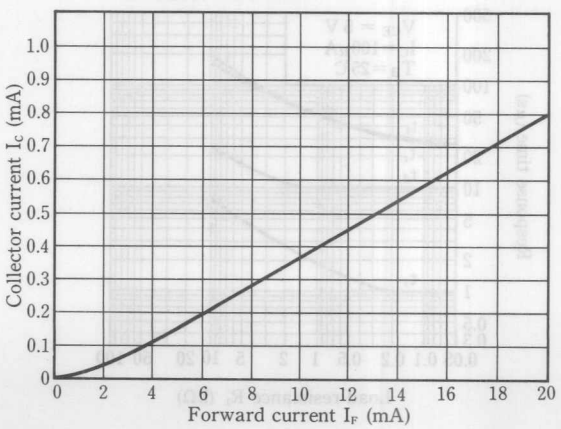


Fig. 4 Collector Current vs. Forward Current



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Fig. 5 Collector Current vs. Collector-emitter Voltage

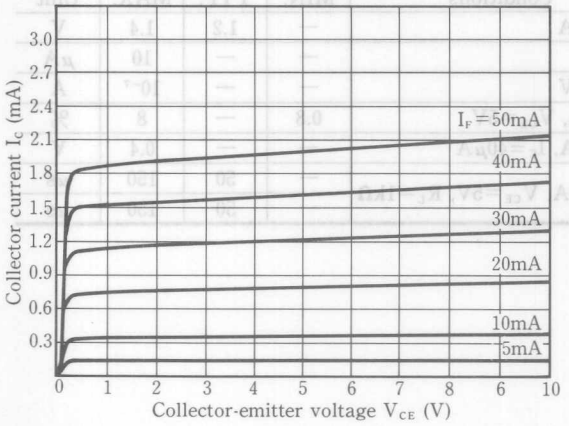


Fig. 6 Collector Current vs. Ambient Temperature

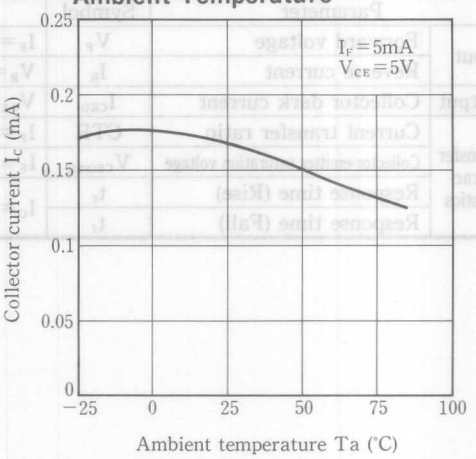


Fig. 7 Collector-emitter Voltage vs. Ambient Temperature

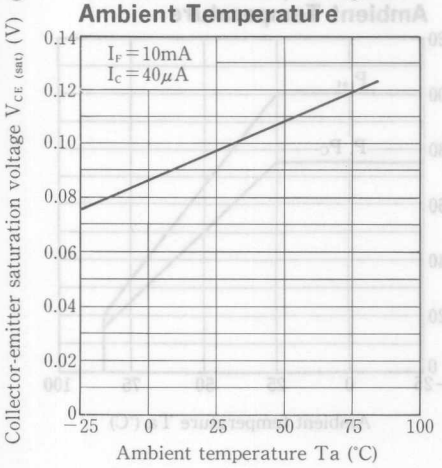


Fig. 8 Collector Dark Current vs. Ambient Temperature

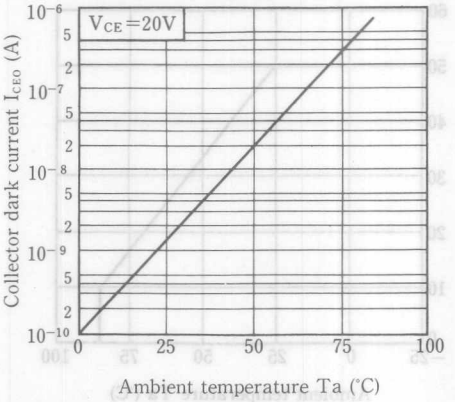
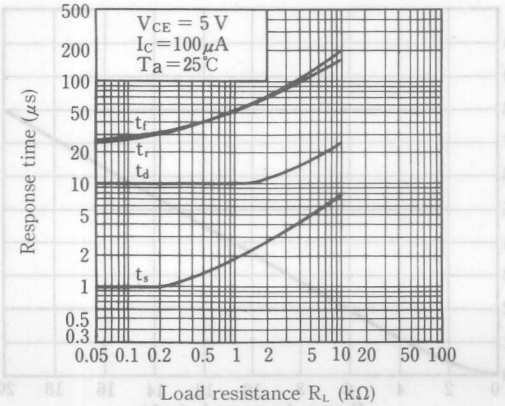


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

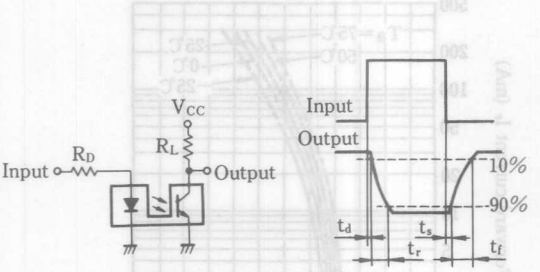
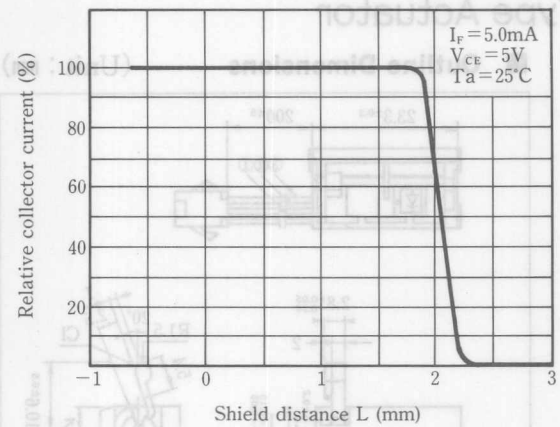


Fig. 10 Relative Collector Current vs. Shield Distance (1)



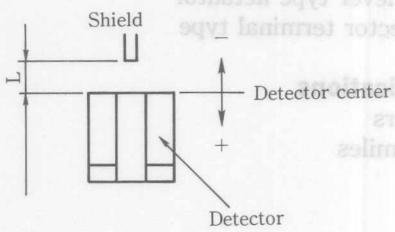
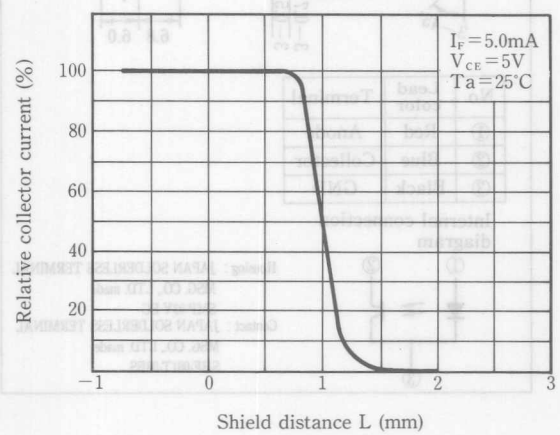
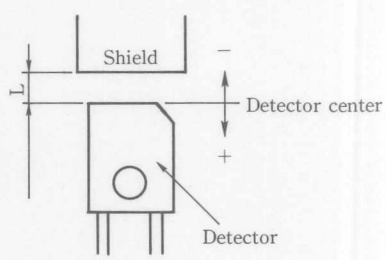


Fig. 11 Relative Collector Current vs. Shield Distance (2)





7

GP1S40 Connecter Terminal Type Photointerrupter with Lever Type Actuator

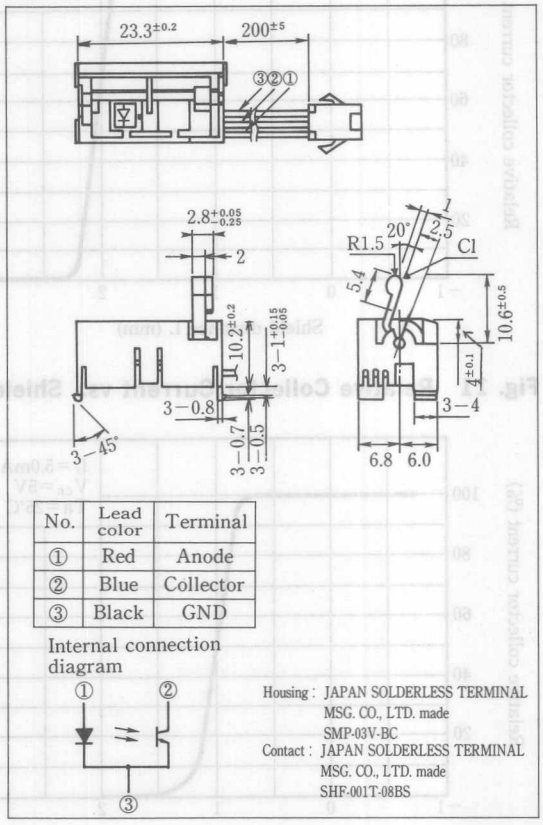
■ Features

1. With lever type actuator
2. Connector terminal type

■ Applications

1. Copiers
2. Facsimiles

■ Outline Dimensions (Unit : mm)



No.	Lead color	Terminal
①	Red	Anode
②	Blue	Collector
③	Black	GND

Internal connection diagram

Housing : JAPAN SOLDERLESS TERMINAL MSG. CO., LTD. made SMP-03V-BC
Contact : JAPAN SOLDERLESS TERMINAL MSG. CO., LTD. made SHF-001T-08BS

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+75	°C
Storage temperature		T_{stg}	−30～+85	°C

*1 Pulse width=100μs, Duty ratio=0.01

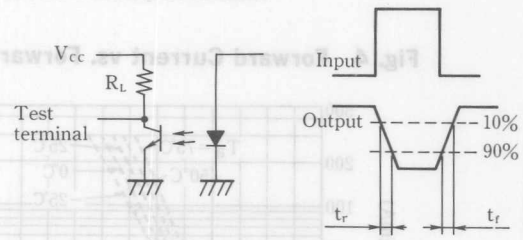
■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=20mA	—	1.25	1.4	V
	Peak forward voltage		V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Collector dark current		I_{CEO}	V_{CE}=20V	—	1	100	nA
Transfer chracteristics	Collector current		I_C	V_{CE}=5V, I_F=20mA	0.5	—	10.0	mA
	Response time	(Rise)	t_r	V_{CE}=2V, I_C=2mA, R_L=100Ω	—	3	15	μs
		(Fall)	t_f		—	4	20	μs
	Collector-emitter saturation voltage		$V_{CE(sat)}$	I_F=40mA, I_C=0.5mA	—	—	0.4	V

(Note) Measurement of transfer chcaracteristics shall be carried out in light transmitting condition.

Test Circuit for Response Time

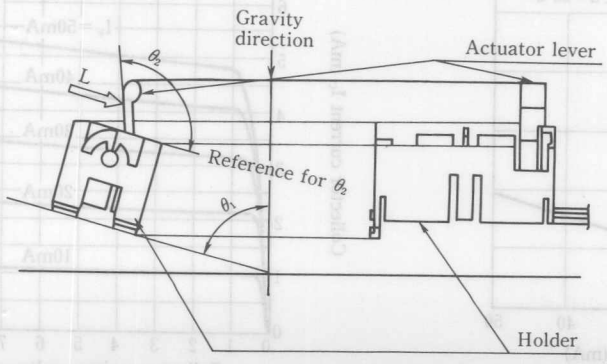


■ Mechanical Characteristics

Parameter	Symbol	Requirements
Mounting angle	θ_1	75±3°
Opaque angle*1	θ_2	85°MAX, 50°MIN.*2
Actuator lever operating load	L	0.5g or more in the arrow-indicated direction as shown in figure below.

*1 Shielding light is defined as a condition with the actuator lever operating in the direction indicated by the arrow in the figure below in which the collector current (Ic) is reduced to 10% or less as compared to 100% for the condition in which the load on the actuator lever is 0g with the device mounted at the angle of 75±3°.

*2 If θ_2 comes into 48° or less, actuator lever causes to break or to transform due to holder touching.



7

Fig. 1 Forward Current vs. Ambient Temperature

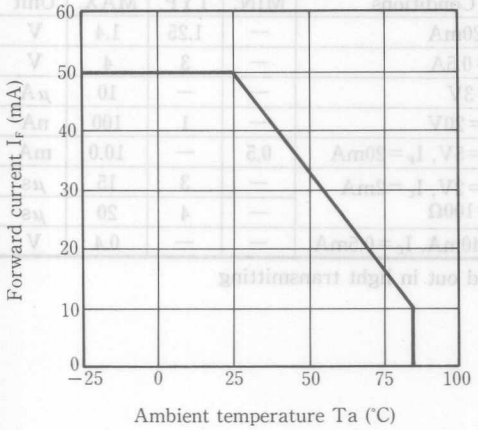


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

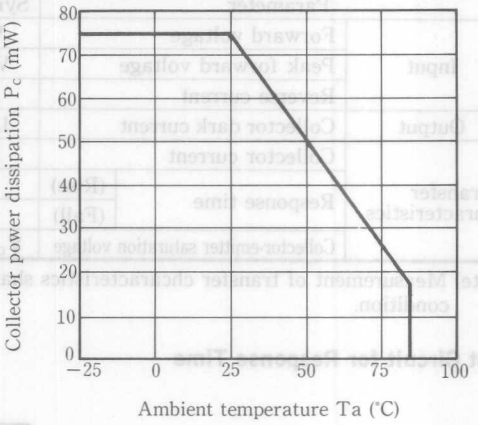


Fig. 3 Peak Forward Current vs. Duty Ratio

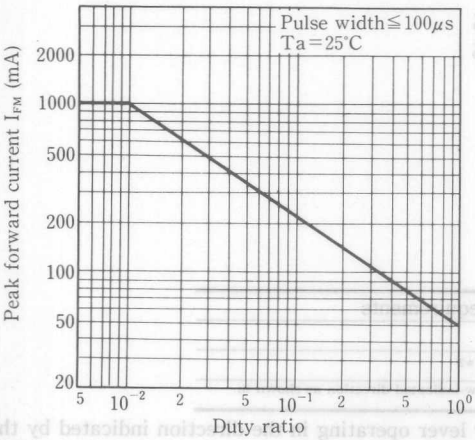


Fig. 4 Forward Current vs. Forward Voltage

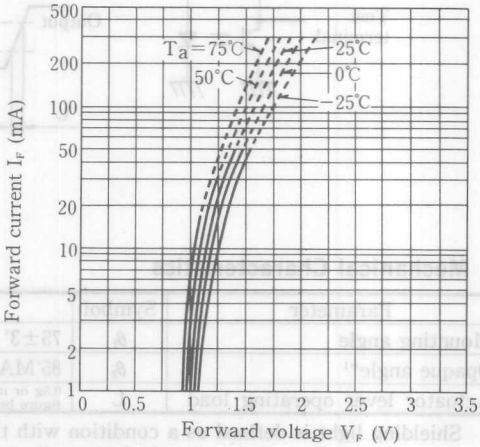


Fig. 5 Collector Current vs. Forward Current

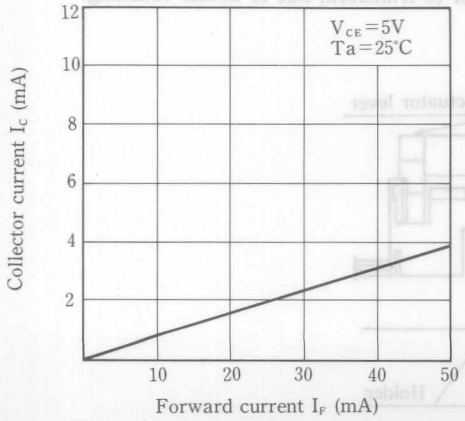


Fig. 6 Collector Current vs. Collector-emitter Voltage

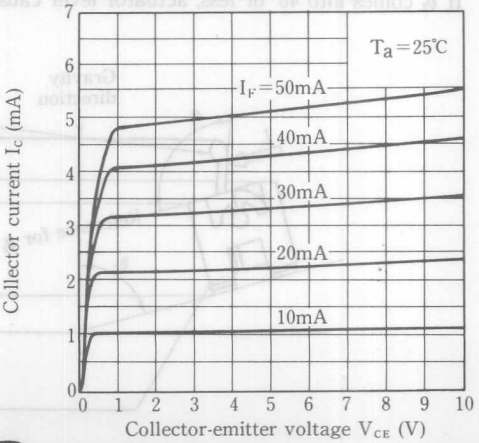


Fig. 7 Collector Current vs. Ambient Temperature

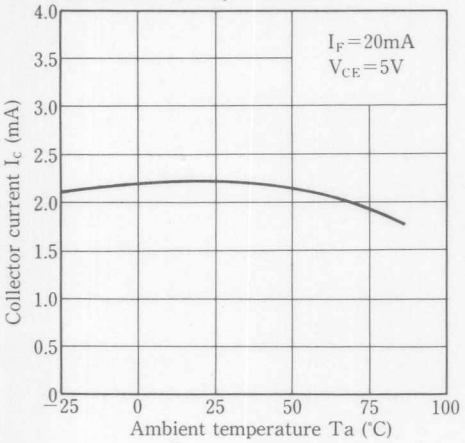


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

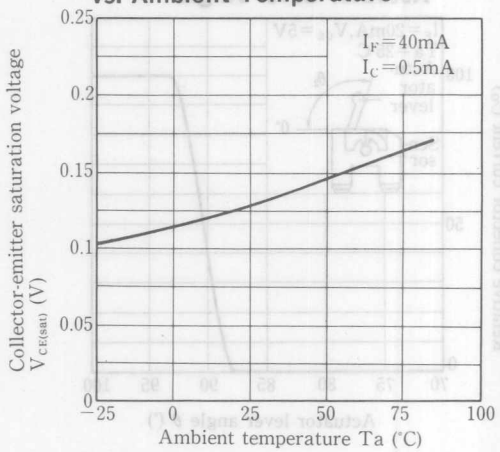
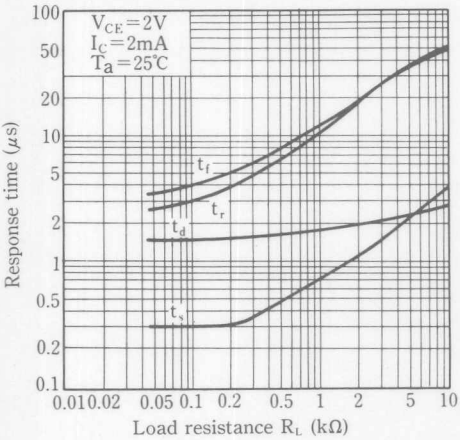


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

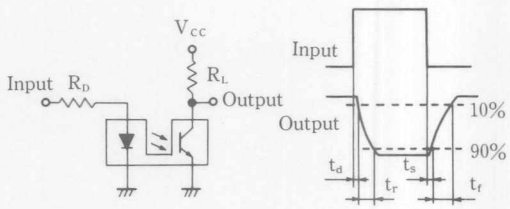


Fig. 10 Frequency Response

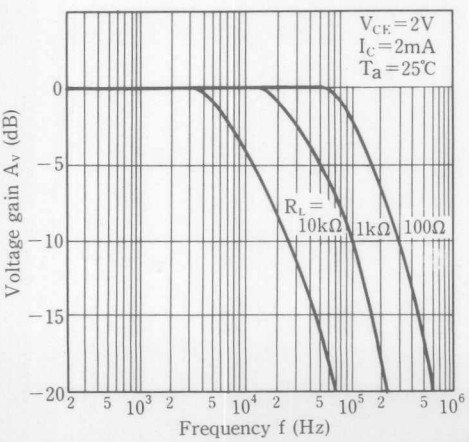
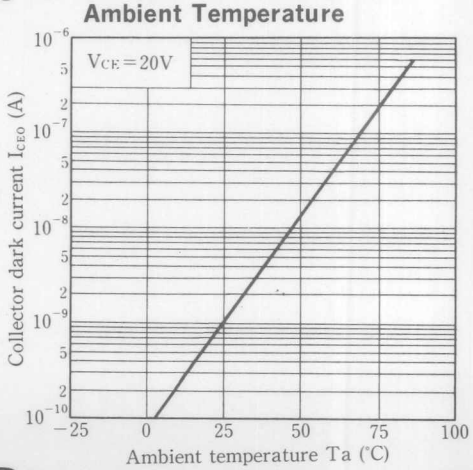
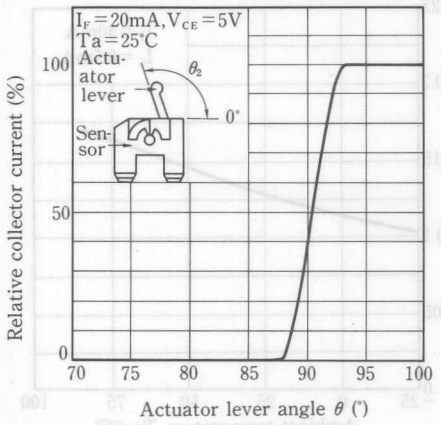


Fig. 11 Collector Dark Current vs. Ambient Temperature



7

Fig. 12 Relative Collector Current vs. Actuator Lever Angle



GP1S41 Photointerrupter with Spring Lever Type Actuator

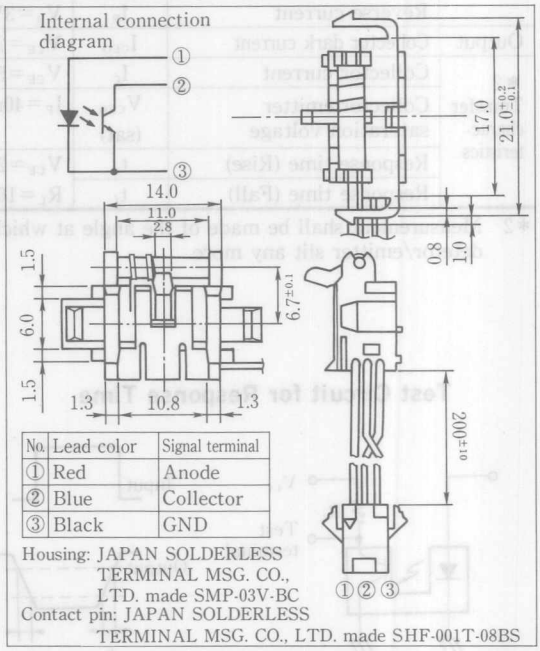
■ Features

1. With spring recoil type actuator
2. Connector terminal type

■ Applications

1. Paper detection for copiers, facsimiles

■ Outline Dimensions (Unit : mm)



No.	Lead color	Signal terminal
①	Red	Anode
②	Blue	Collector
③	Black	GND

Housing: JAPAN SOLDERLESS TERMINAL MSG. CO., LTD. made SMP-03V-BC
Contact pin: JAPAN SOLDERLESS TERMINAL MSG. CO., LTD. made SHF-001T-08BS

7

■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+75	°C
	Storage temperature	T_{stg}	−30～+85	°C

*1 Pulse width ≦ 100μs, Duty ratio=0.01

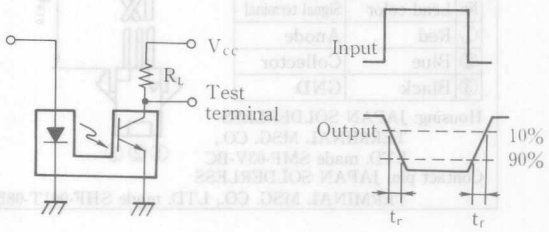
■ Electro-optical Characteristics

(Ta=25°C)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.25	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	1	100	nA
*2 Transfer characteristics	Collector current	I_C	V_{CE}=5V, I_F=20mA	0.5	—	10	mA
	Collector-emitter saturation voltage	V_{CEO} (sat)	I_F=40mA, I_C=0.05mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	3	15	μs
	Response time (Fall)	t_f	R_L=100Ω	—	4	20	μs

*2 Measurement shall be made of the angle at which the actuator lever transmits the light going through light detetor/emitter slit any more.

Test Circuit for Response Time



■ Mechanical Characteristics

Parameter	Conditions	MIN.	TYP.	MAX.	Unit
Lever rotational torque	With the actuator lever horizontal (Initial condition)	—	—	2	gf • cm
Lever life		100,000	—	—	Times

Fig. 1 Forward Current vs. Ambient Temperature

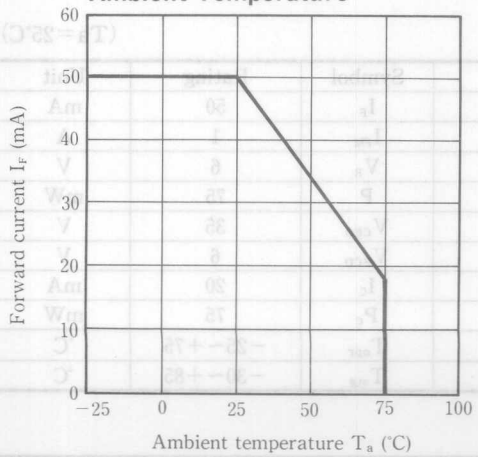


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

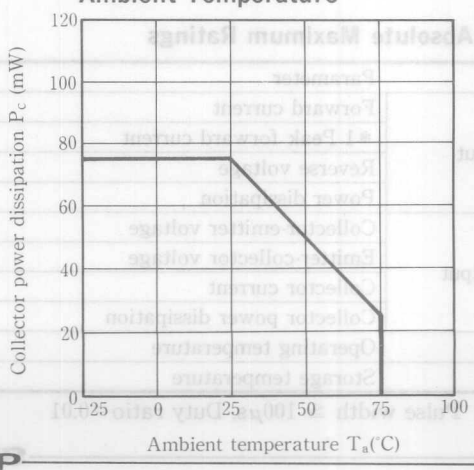


Fig. 3 Peak Forward Current vs. Duty Ratio

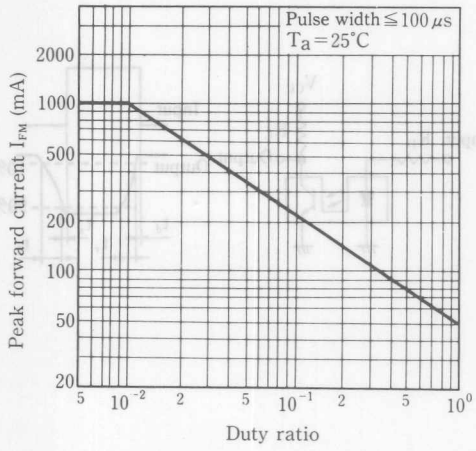


Fig. 4 Forward Current vs. Forward Voltage

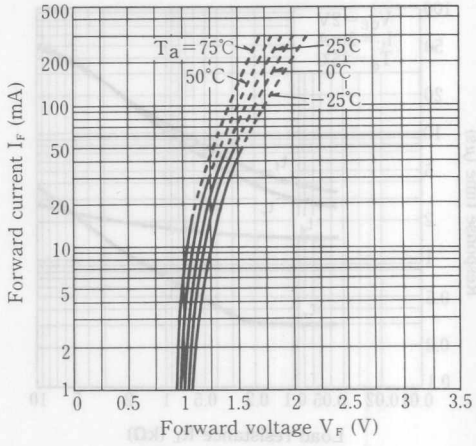


Fig. 5 Collector Current vs. Forward Current

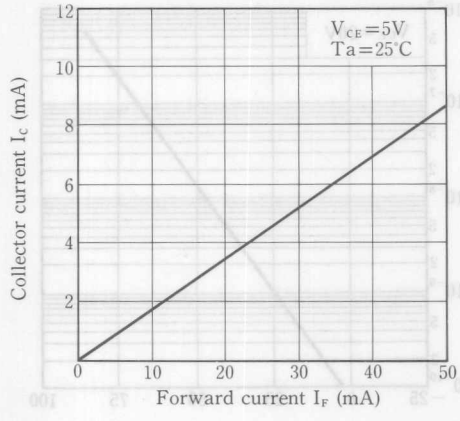


Fig. 6 Collector Current vs. Collector-emitter Voltage

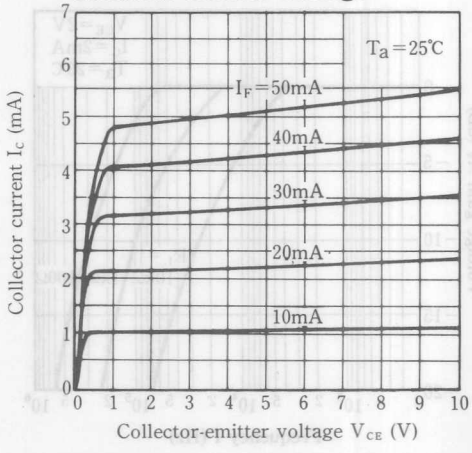


Fig. 7 Collector Current vs. Ambient Temperature

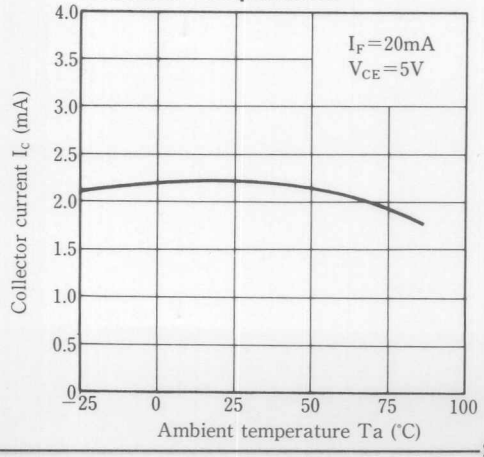
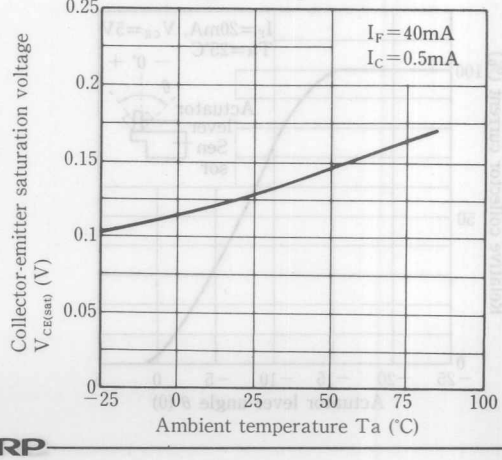
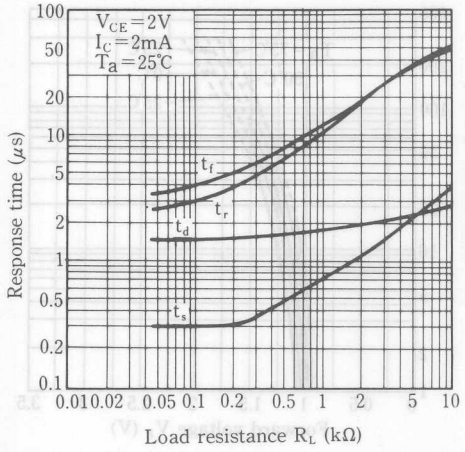


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature



7

Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

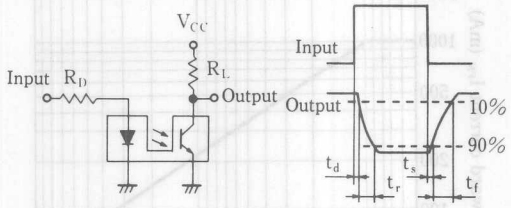


Fig. 10 Frequency Response

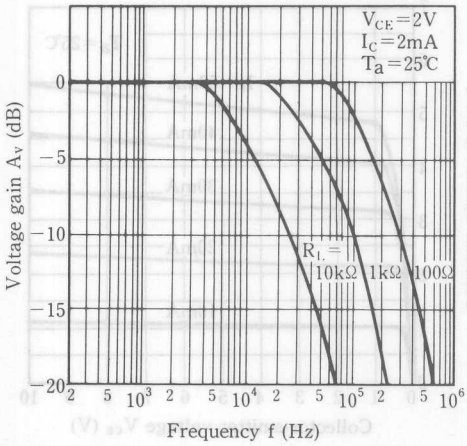


Fig. 11 Collector Dark Current vs. Ambient Temperature

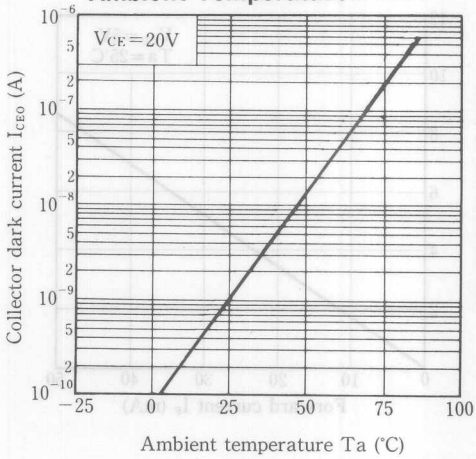
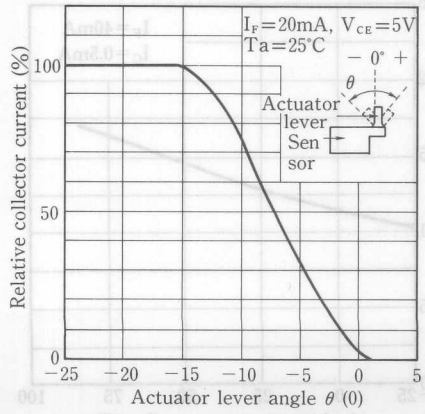


Fig. 12 Relative Collector Current vs. Actuator Lever Angle



GP1S50/GP1S51 /GP1S52

Compact Potointerrupter

■ Features

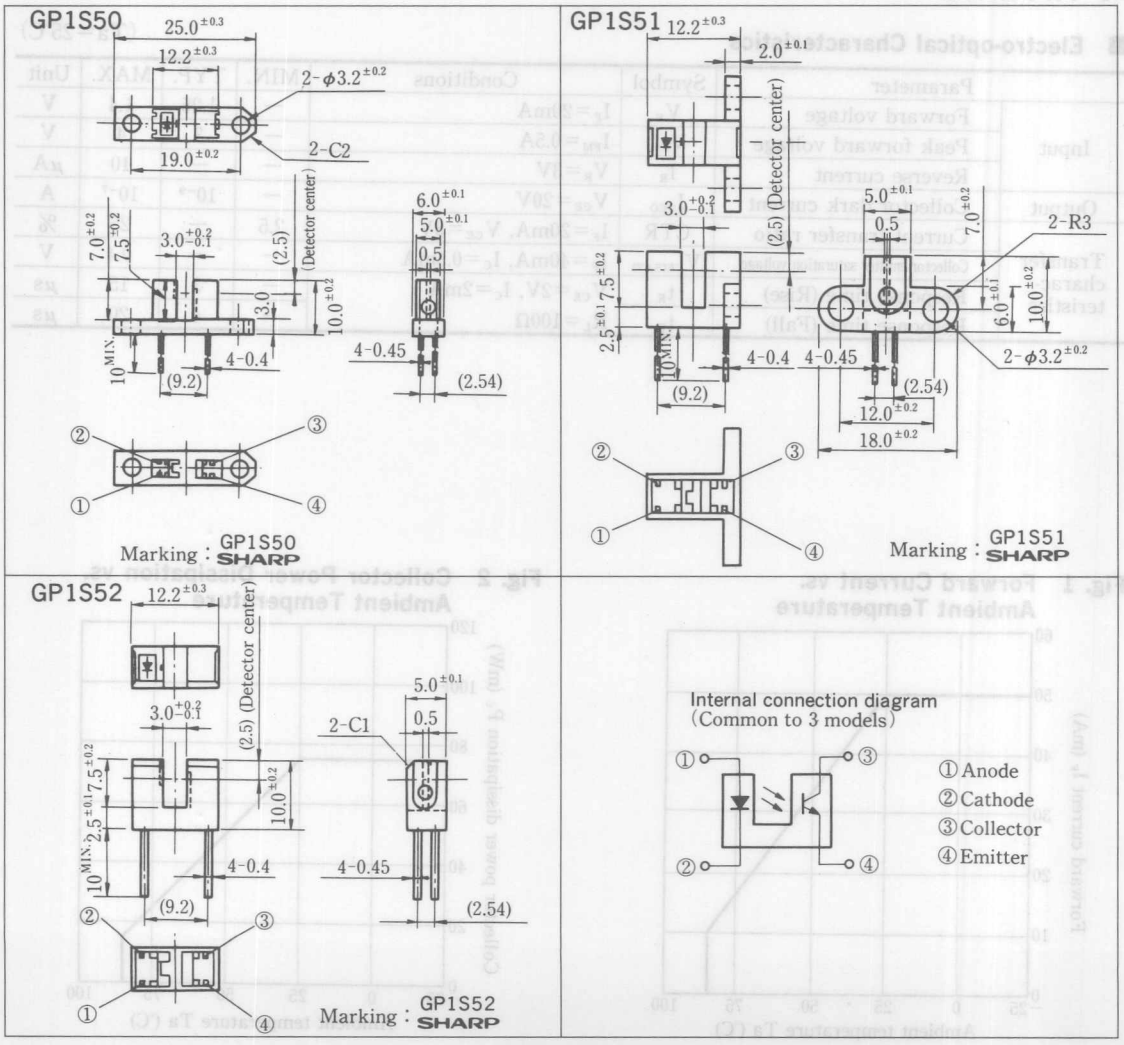
1. Compact type
2. High sensing accuracy (Slilt width : 0.5mm)
3. Both-sides mounting type : GP1S50
   Either-side mounting type : GP1S51
   PWB direct mounting type : GP1S52

■ Applications

1. OA equipment, such as FDDs, printers, facsimiles
2. VCRs

■ Outline Dimensions

(Unit : mm)



7

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collecter-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collecter power dissipation	P_C	75	mW
Operating temperature		T_{OPR}	−25～+85	°C
Storage temperature		T_{STG}	−40～+100	°C
*2Soldering temperature		T_{SOL}	260	°C

*1 Pulsj width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.25	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	2.5	—	25	%
	Collector-emitter saturation voltage	$V_{CE(SAT)}$	I_F=40mA, I_C=0.5mA	—	—	0.4	V
	Response time (Rise)	t_R	V_{CE}=2V, I_C=2mA	—	3	15	μs
	Response time (Fall)	t_F	R_L=100Ω	—	4	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

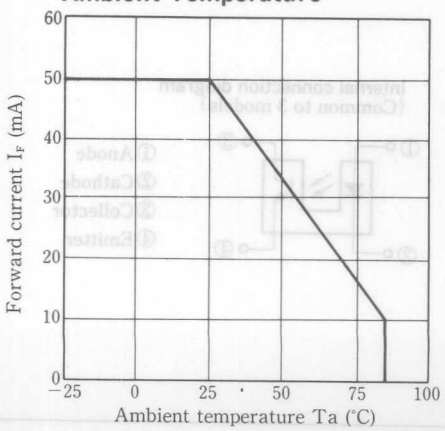


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

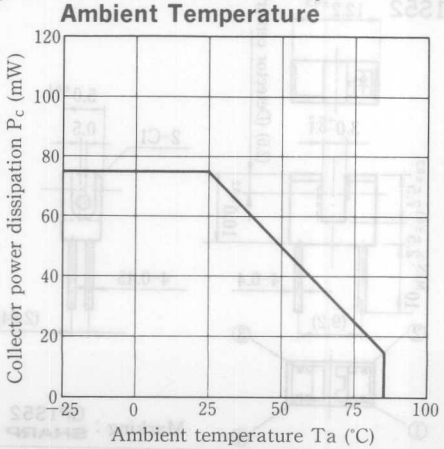


Fig. 3 Peak Forward Current vs. Duty Ratio

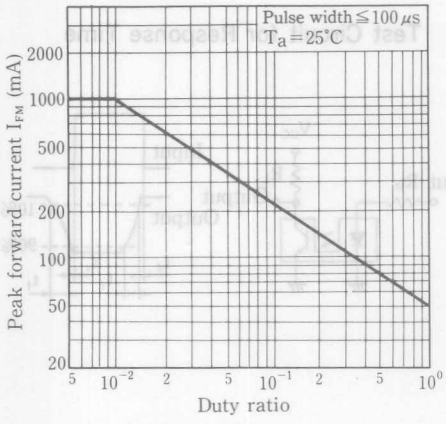


Fig. 4 Forward Current vs. Forward Voltage

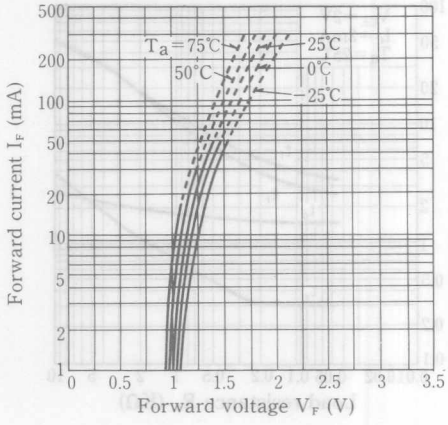


Fig. 5 Collector Current vs. Forward Current

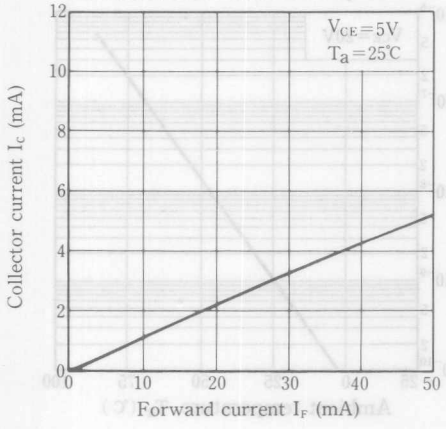


Fig. 6 Collector Current vs. Collector-emitter Voltage

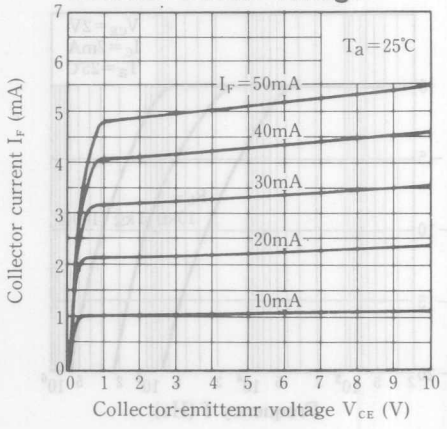


Fig. 7 Collector Current vs. Ambient Temperature

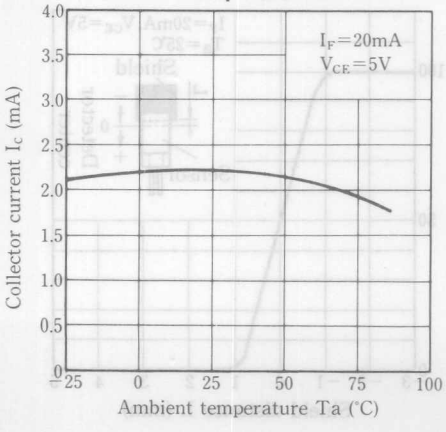
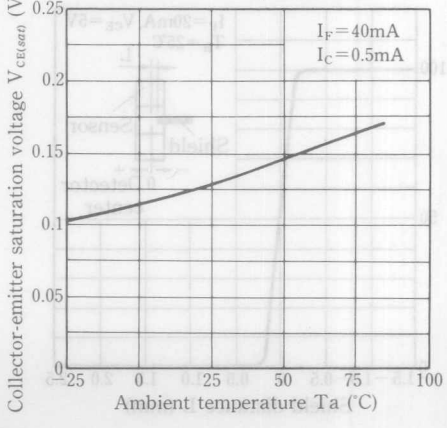
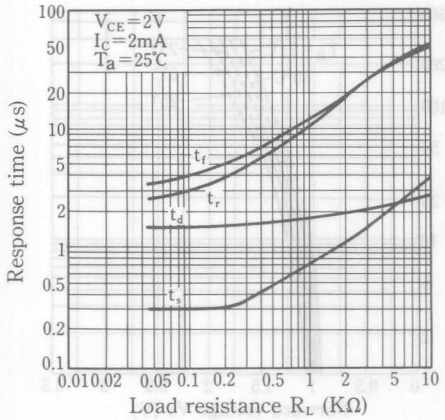


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature



7

Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

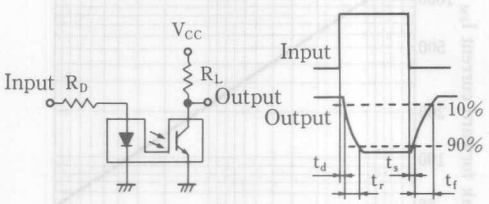


Fig. 10 Frequency Response

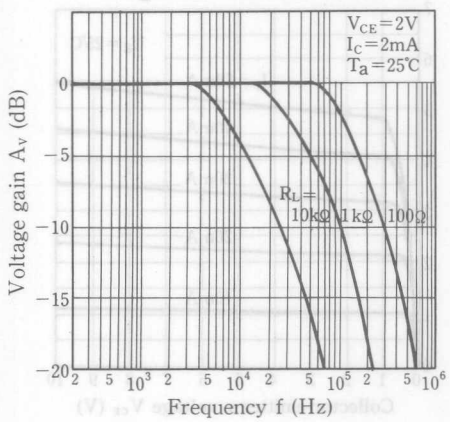


Fig. 11 Collector Dark Current vs. Ambient Temperature

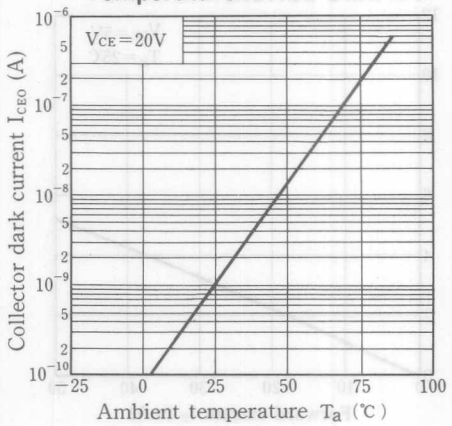


Fig. 12 Relative Collector Current vs. Shield Distance (1)

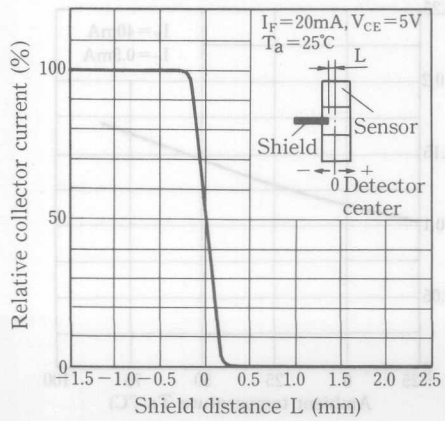
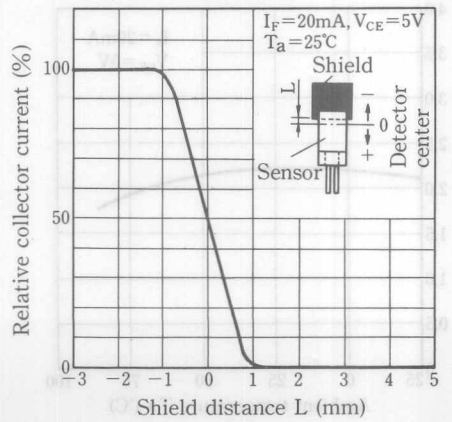


Fig. 13 Relative Collector Current vs. Shield Distance (2)



GP1S53 Compact Potointerrupter

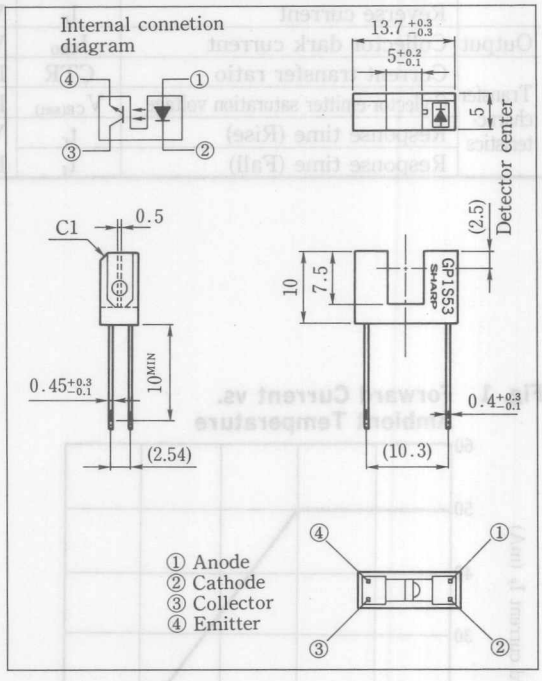
■ Features

1. Compact type
2. High sensing accuracy (Slilt width: 0.5mm)
3. PWB mounting type

■ Applications

1. OA equipment, such as FDDs, printers, facsimiles
2. VCRs
3. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Rating (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Cellector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.25	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	2.5	—	75	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=0.2mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	3	15	μs
	Response time (Fall)	t_f	R_L=100Ω	—	4	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

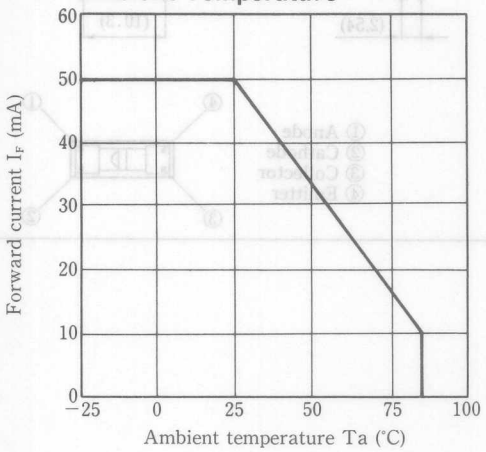


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

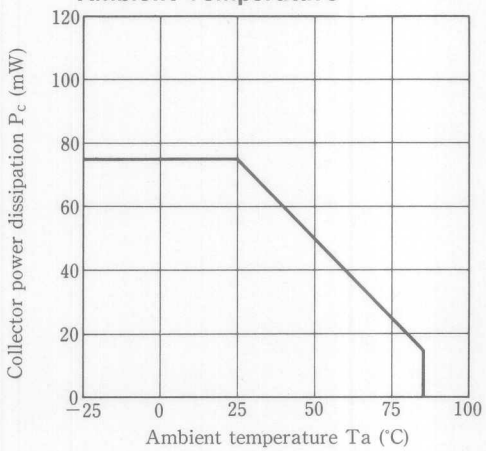


Fig. 3 Peak Forward Current vs. Duty Ratio

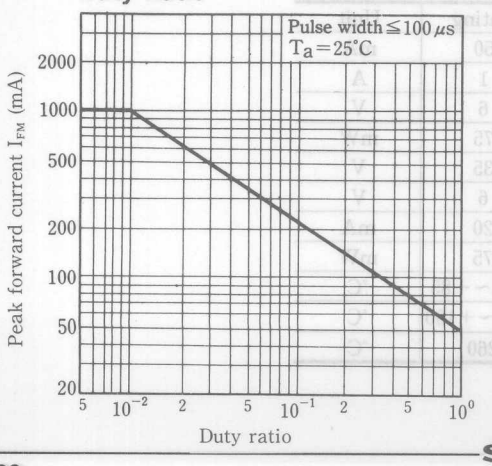


Fig. 4 Forward Current vs. Forward Voltage

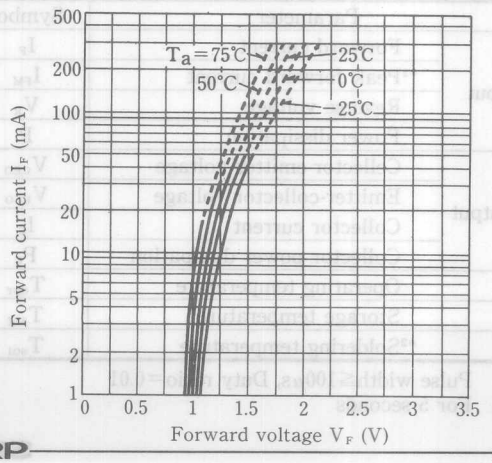


Fig. 5 Collector Current vs. Forward Current

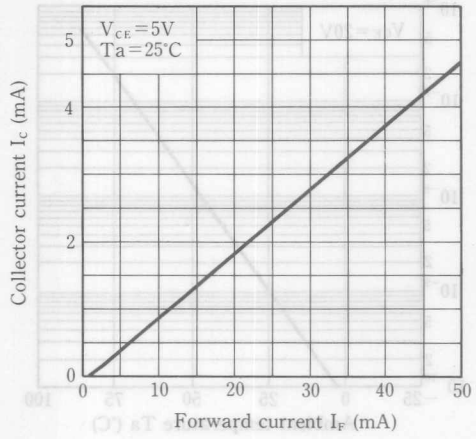


Fig. 6 Collector Current vs. Collector-emitter Voltage

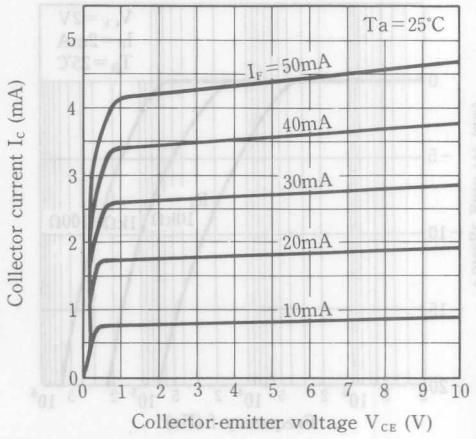


Fig. 7 Collector Current vs. Ambient Temperature

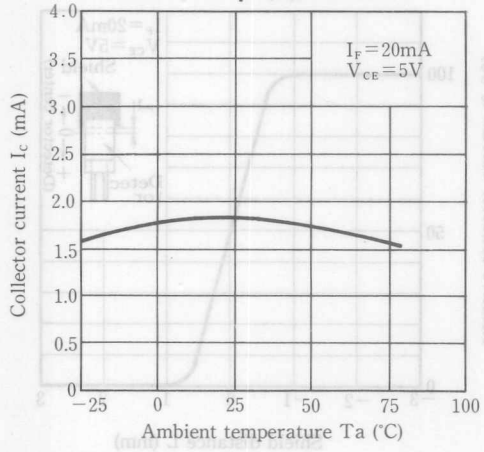


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

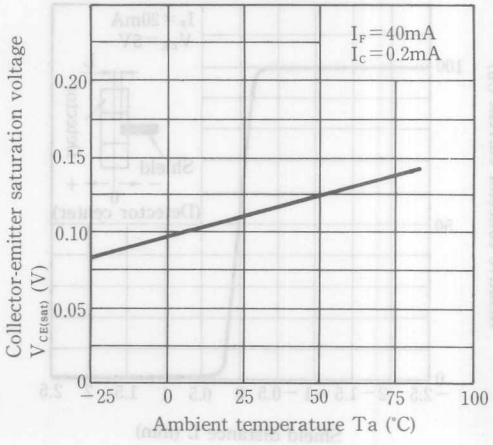
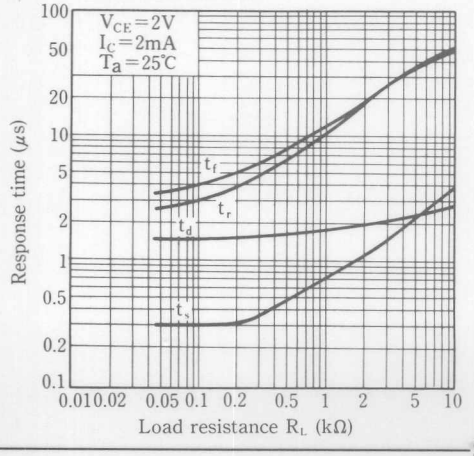
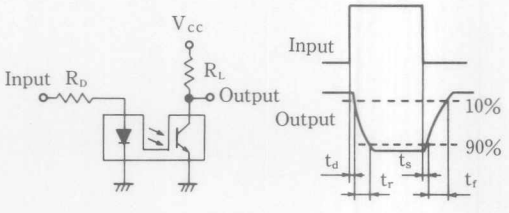


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

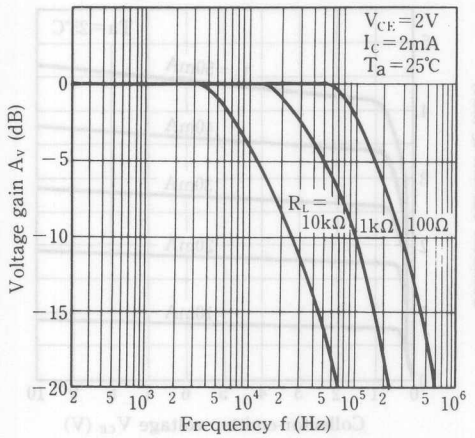


Fig. 11 Collector Dark Current vs. Ambient Temperature

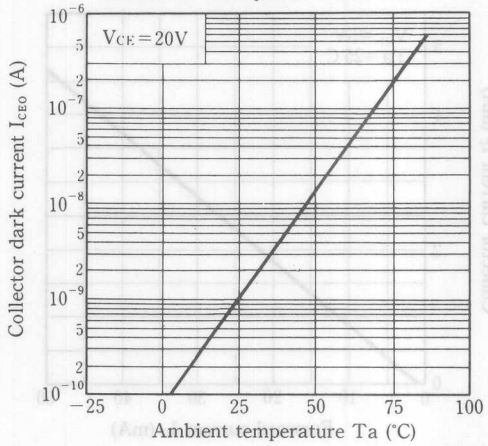


Fig. 12 Relative Collector Current vs. Shield Distance (1)

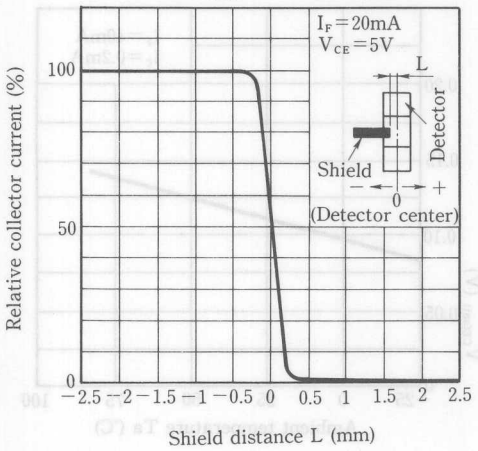
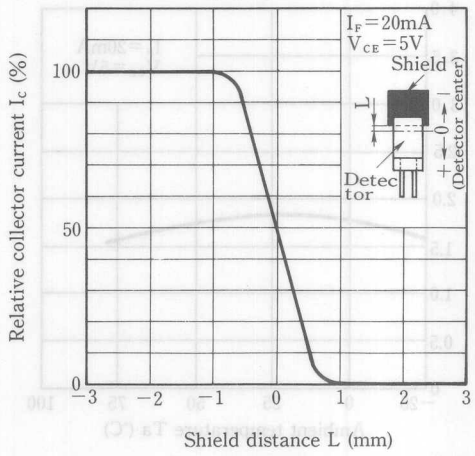


Fig. 13 Relative collector Current vs. Shield Distance (2)



GP1S54 Compact Potointerrupter

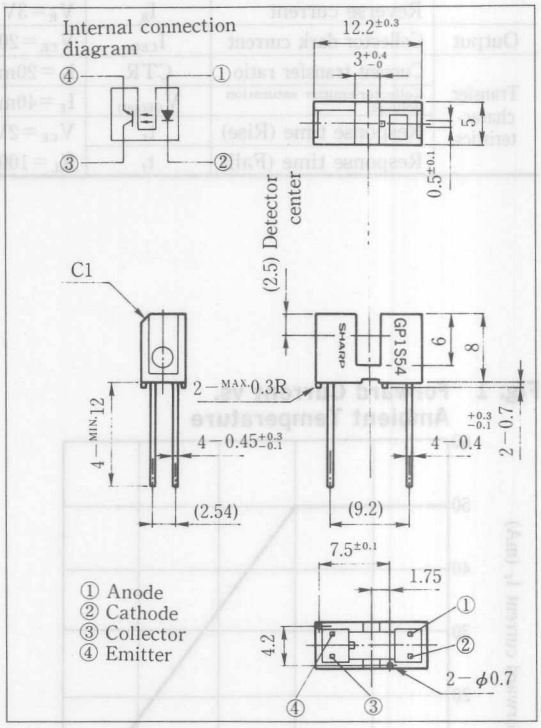
■ Features

1. Compact type (case height: 8mm)
2. High sensing accuracy (Slilt width: 0.5mm)
3. PWB mounting type with positioning pin

■ Applications

1. OA equipment such as FDDs, printers, facsimiles, etc.
2. VCRs

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width ≦ 100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

	Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	2.5	—	25	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=0.5mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	3	15	μs
	Response time (Fall)	t_f	R_L=100Ω	—	4	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

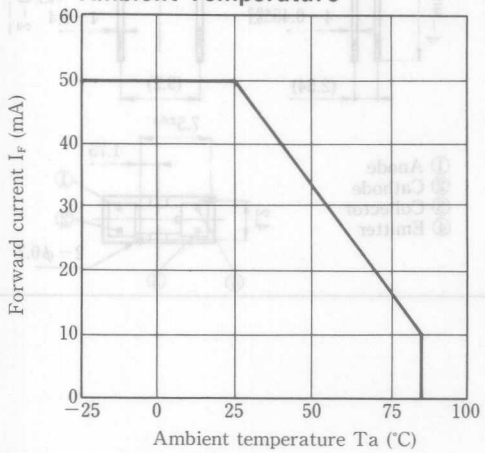


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

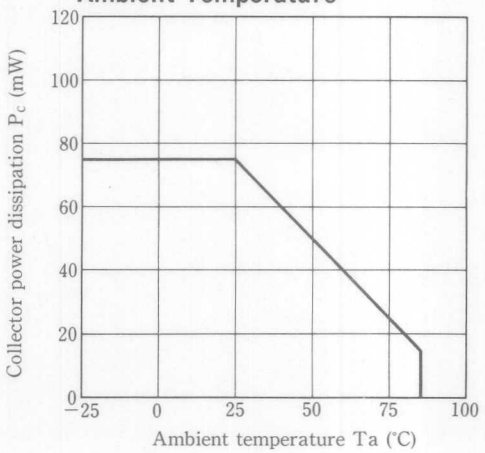


Fig. 3 Peak Forward Current vs. Duty Ratio

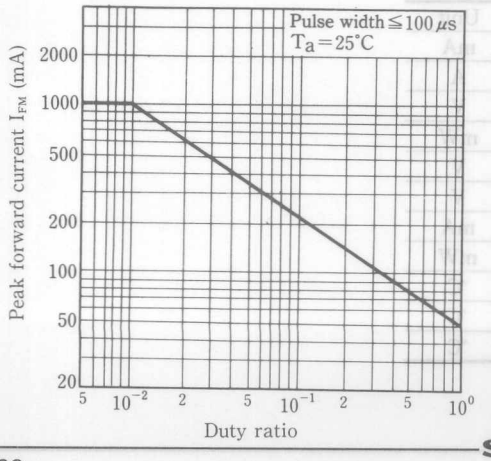


Fig. 4 Forward Current vs. Forward Voltage

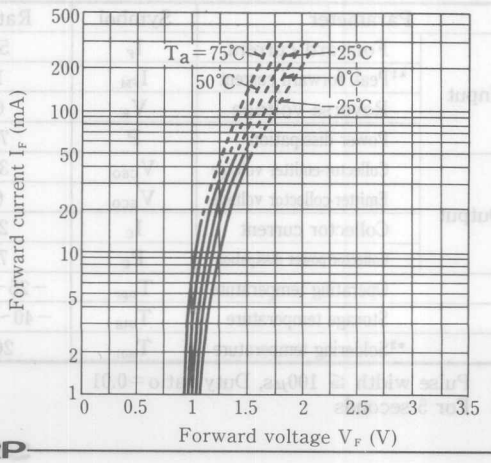


Fig. 5 Collector Current vs. Forward Current

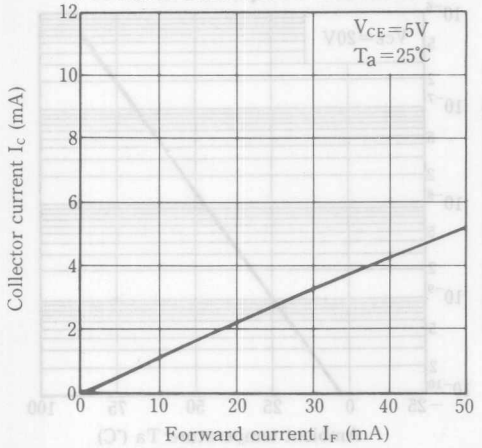


Fig. 6 Collector Current vs. Collector-emitter Voltage

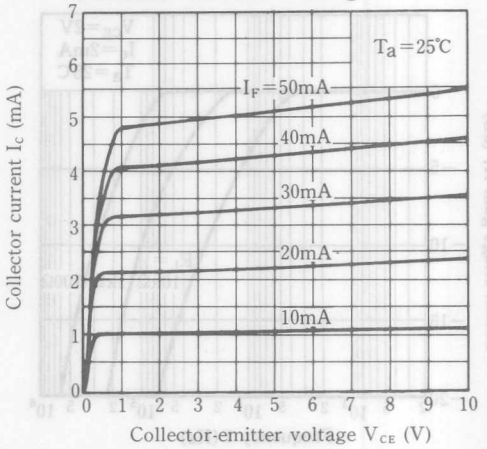


Fig. 7 Collector Current vs. Ambient Temperature

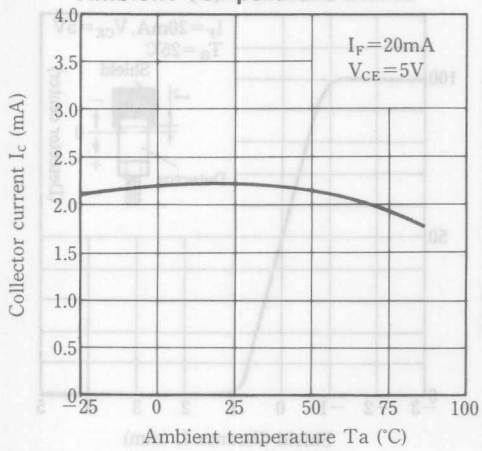


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

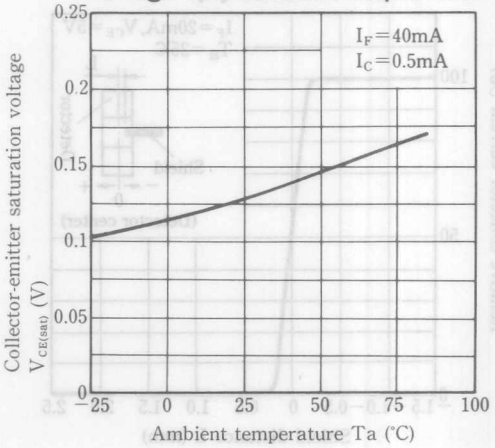
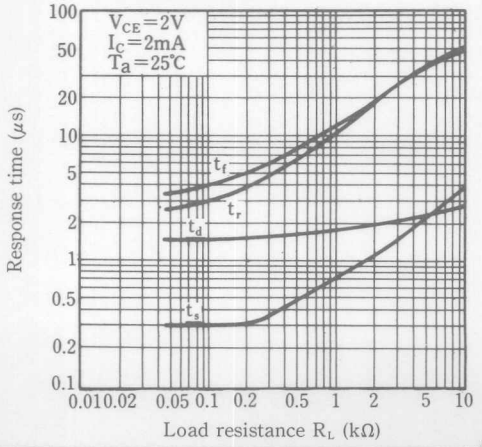
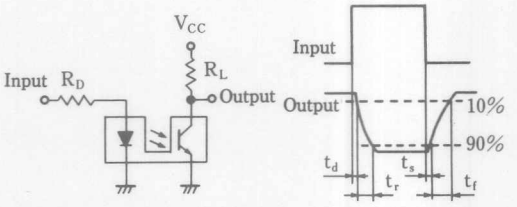


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

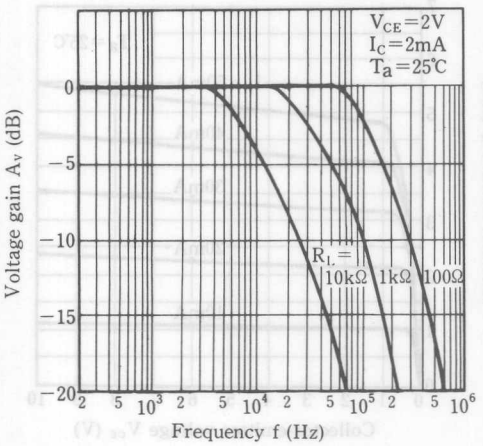


Fig. 11 Collector Dark Current vs. Ambient Temperature

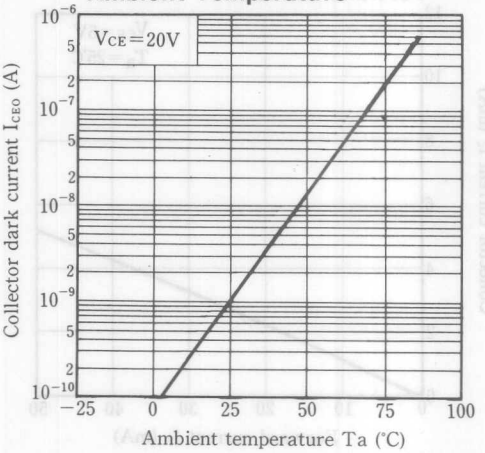


Fig. 12 Relative Collector Current vs. Shield Distance (1)

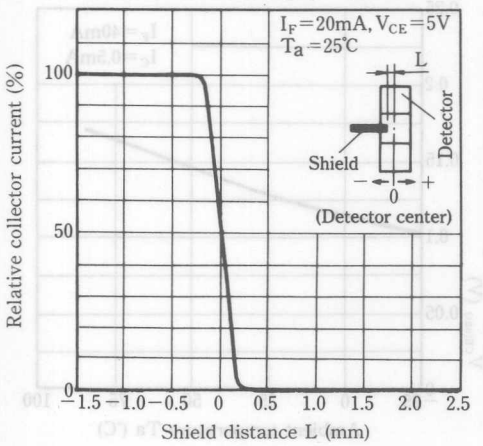
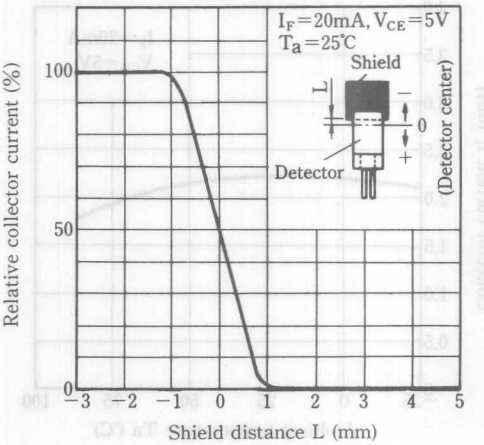


Fig. 13 Relative Collector Current vs. Shield Distance (2)



GP1S55 Narrow Gap Type Photointerrupter

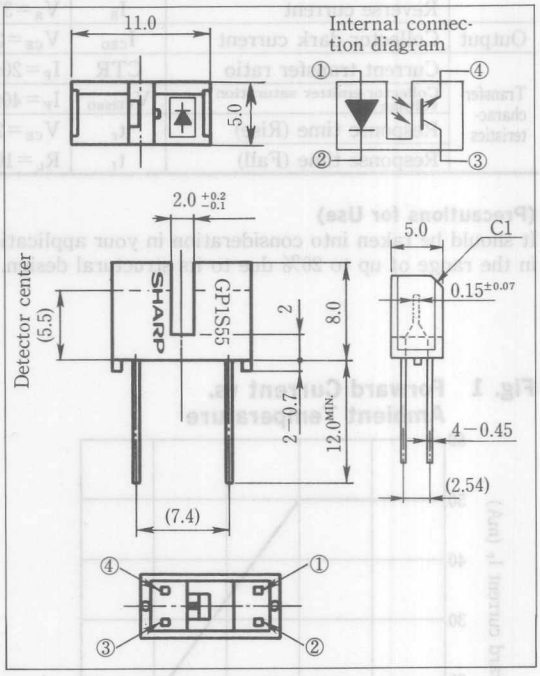
■ Features

1. High sensing accuracy
   (Slit width : 0.15mm)
2. Easy positioning to PWB with positioning pin
3. Compact package
   (Case height : 8mm)

■ Applications

1. Floppy disk drives
2. VCRs, Cassette decks
3. Optoelectronic switches, electronic counters, edge sensors

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collectot voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2 Soldering temperature	T_{sol}	260	°C

※1 Pulse width≦100μs, Duty ratio=0.01
※2 For 5 seconds

7

■ Electro-optical Chracteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	3	—	—	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=0.6mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	5	25	μs
	Response time (Fall)	t_f	R_L=100Ω	—	6	30	μs

(Precautions for Use)

It should be taken into consideration in your application that vibrations may cause the collector current to vary in the range of up to 20% due to its structural design.

Fig. 1 Forward Current vs. Ambient Temperature

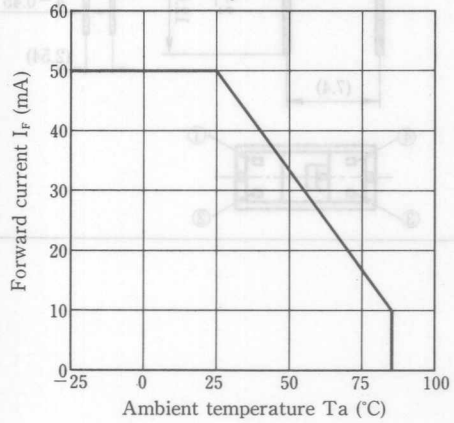


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

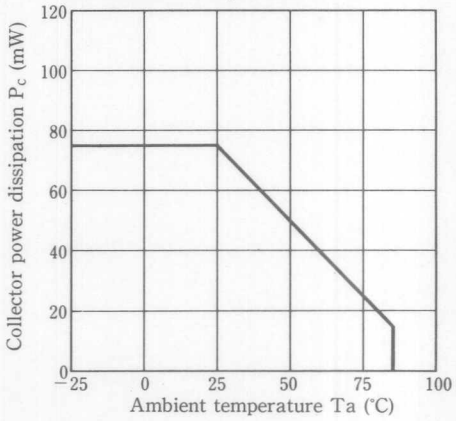


Fig. 3 Peak Forward Current vs. Duty Ratio

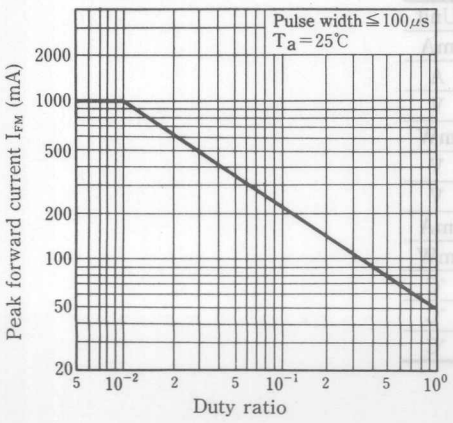


Fig. 4 Forward Current vs. Forward Voltage

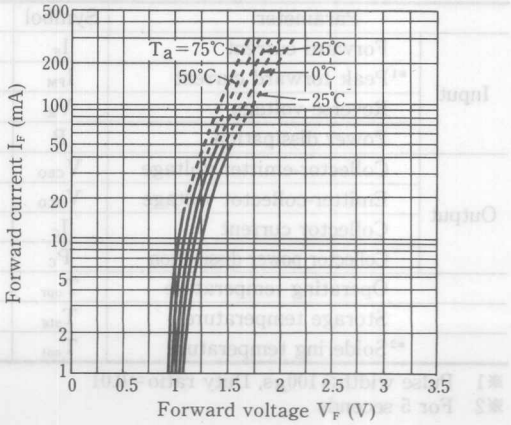


Fig. 5 Collector Current vs. Forward Current

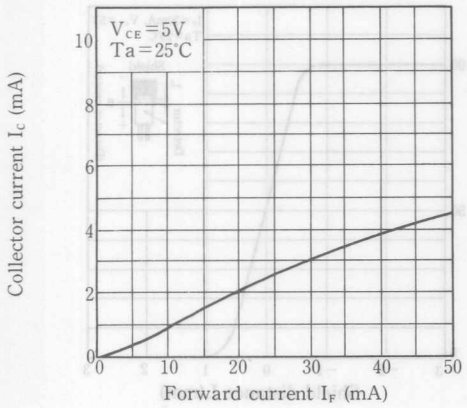


Fig. 6 Collector Current vs. Collector-emitter Voltage

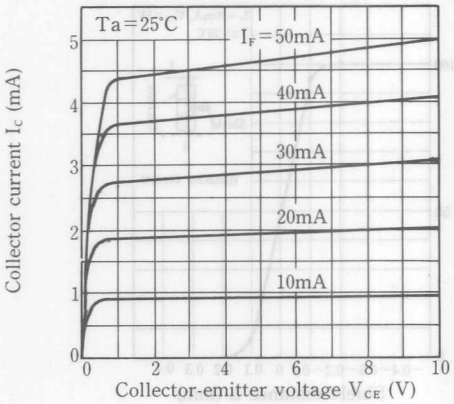


Fig. 7 Collector Current vs. Ambient Temperature

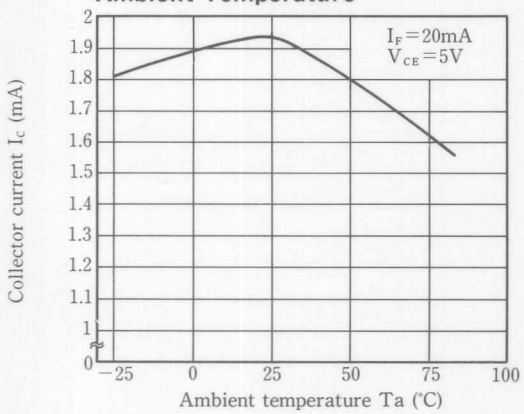


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

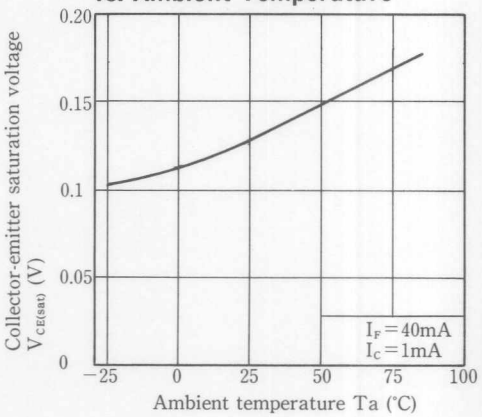
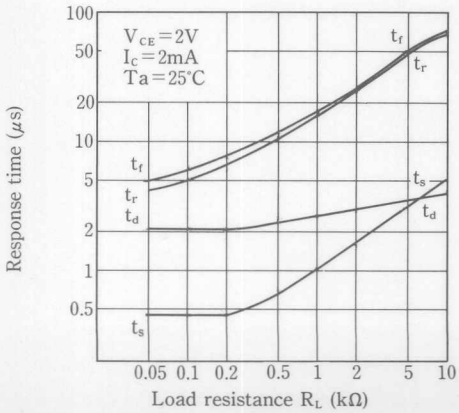
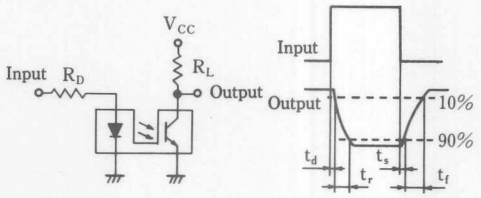


Fig. 9 Response Time vs. Load Resistance





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Fig. 10 Relative Collector Current vs. Shield Distance (1)

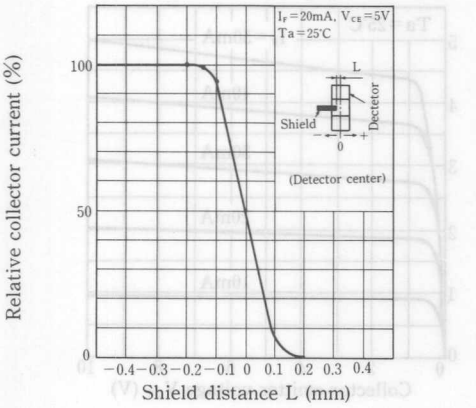
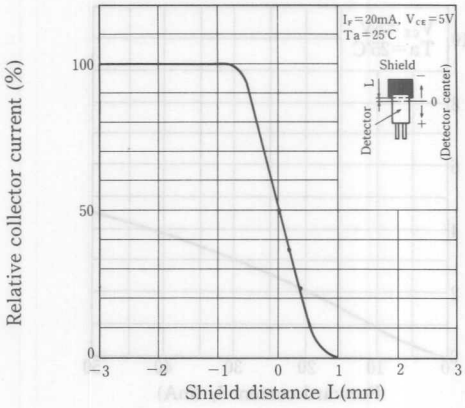


Fig. 11 Relative Collector Current vs. Shield Distance (2)



GP1S56 Compact, High Sensing Accuracy Type Photointerrupter with Positioning Pin

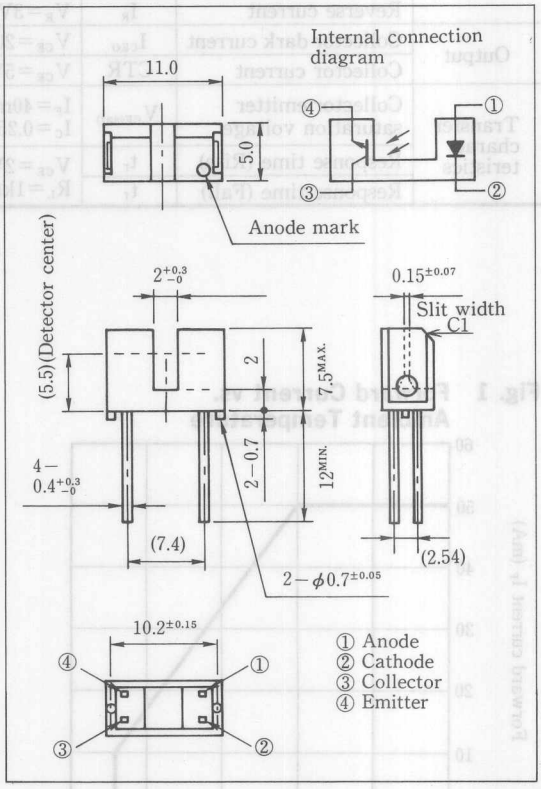
■ Features

1. High sensing accuracy (Slit width : 0.15mm)
2. Compact (Case height : 7.5mm)
3. With positioning pin

■ Applications

1. Floppy disk drives
2. VCRs, cassette decks
3. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	1	100	nA
	Collector current	CTR	V_{CE}=5V, I_F=20mA	20	—	—	%
Transfer characteristics	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=0.25mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=0.5mA R_L=1kΩ	—	38	90	μs
	Response time (Fall)	t_f		—	48	110	μs

Fig. 1 Forward Current vs. Ambient Temperature

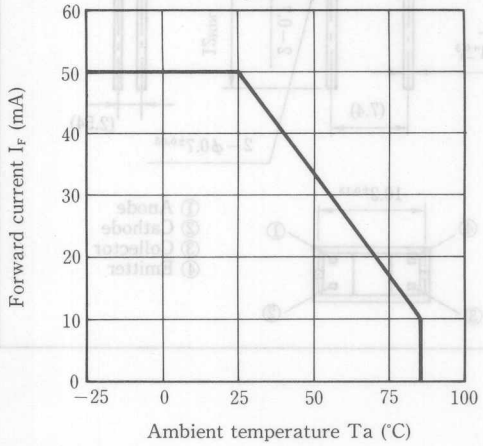


Fig. 2 Collector Power dissipation vs. Ambient Temperature

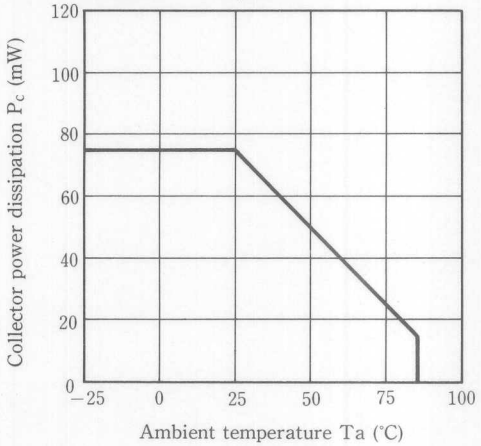


Fig. 3 Peak Forward Current vs. Duty Ratio

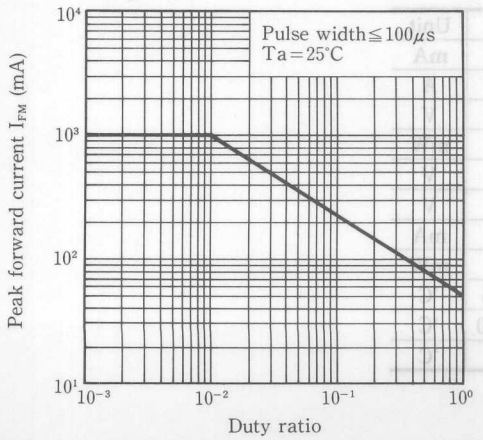


Fig. 4 Forward Current vs. Forward Voltage

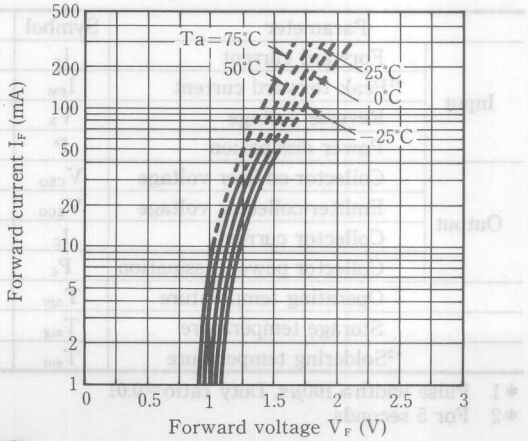


Fig. 5 Collector Current vs. Forward Current

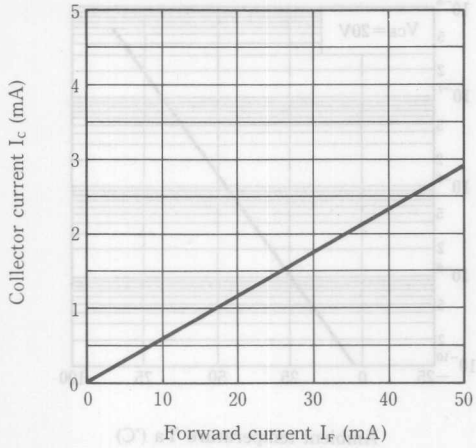


Fig. 6 Collector Current vs. Collector-emitter Voltage

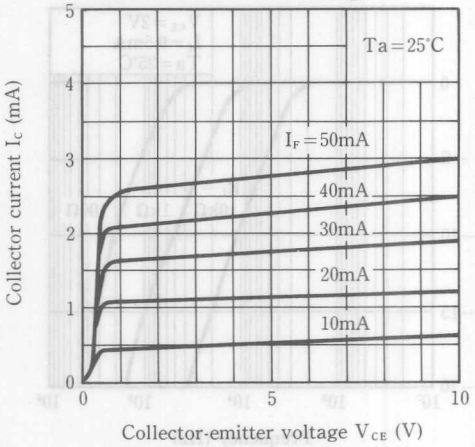


Fig. 7 Collector Current vs. Ambient Temperature

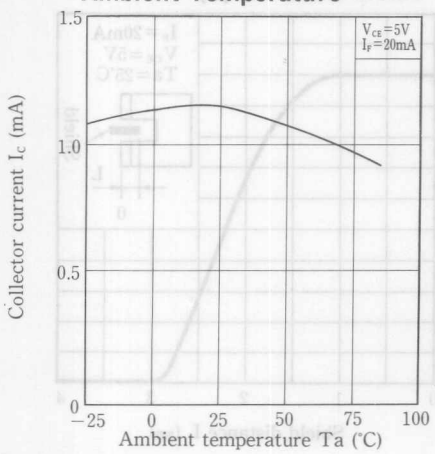


Fig. 8 Collecor-emitter Saturation Voltage vs. Ambient Temperature

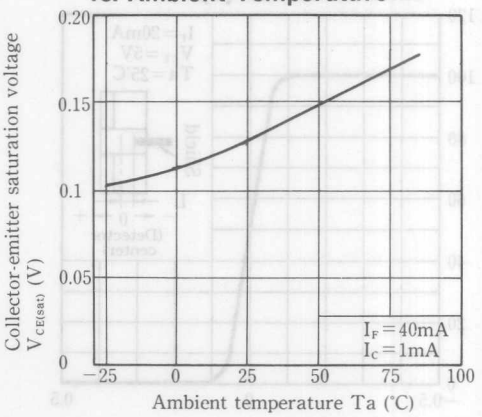
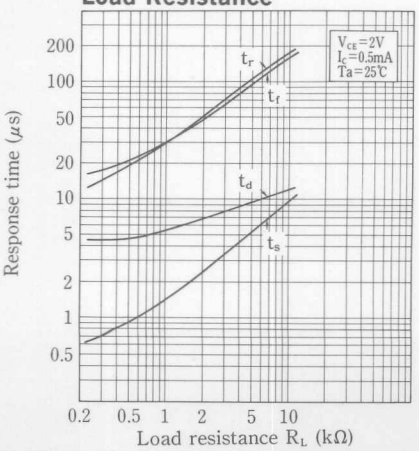
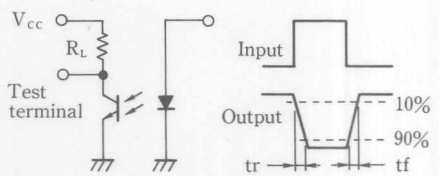


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

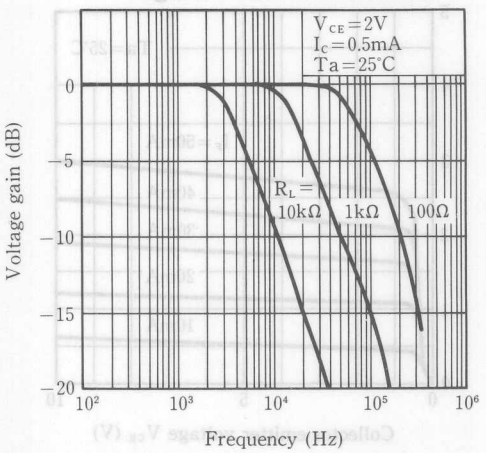


Fig. 11 Collector Dark Current vs. Ambient Temperature

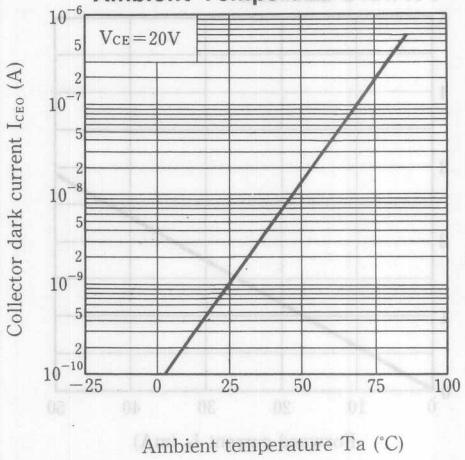


Fig. 12 Relative collector Current vs. Shield Distance (1)

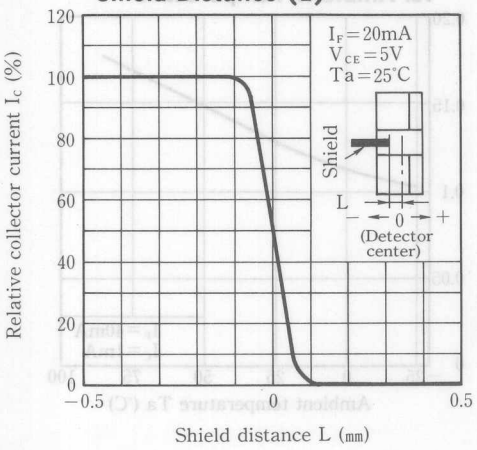
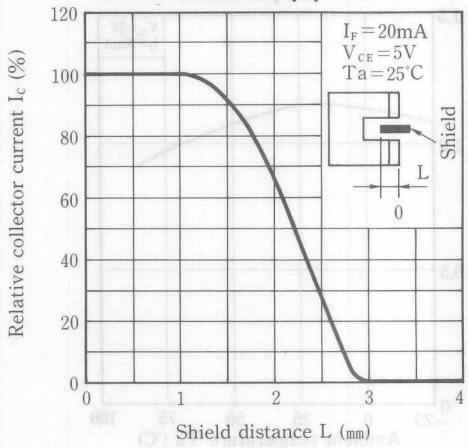


Fig. 13 Relative Collector Current vs. Shield Distance (2)



GP1S560 Compact, High Sensing Accuracy Type Photointerrupter with Positioning Pin

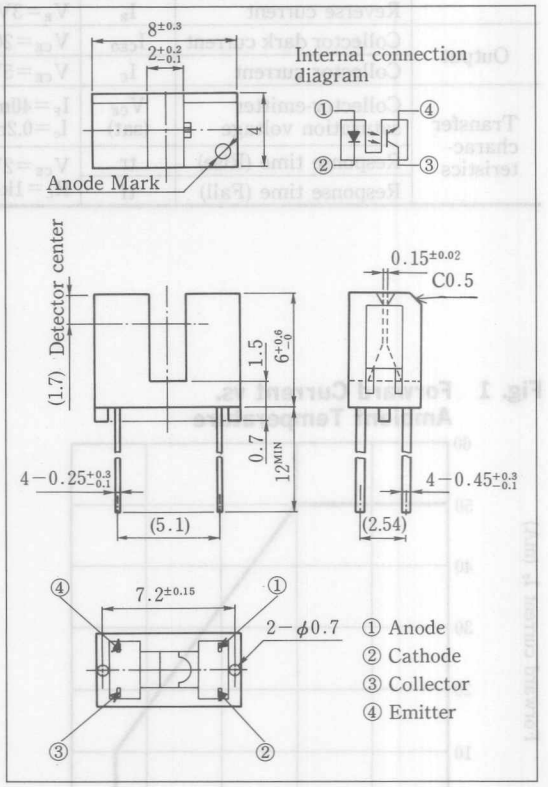
■ Features

1. High sensing accuracy (Slit width : 0.15mm)
2. Compact (Case height : 7.5mm)
3. With positioning pin

■ Applications

1. Floppy disk drives
2. VCRs, cassette decks
3. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	—	100	nA
	Collector current	I_C	V_{CE}=5V, I_F=20mA	0.2	—	—	mA
Transfer characteristics	Collector-emitter saturation voltage	V_{CE} (sat)	I_F=40mA, I_C=0.2mA	—	—	0.4	V
	Response time (Rise)	tr	V_{CE}=2V, I_C=0.5mA R_L=1kΩ	—	38	90	μs
	Response time (Fall)	tf		—	48	100	μs

Fig. 1 Forward Current vs. Ambient Temperature

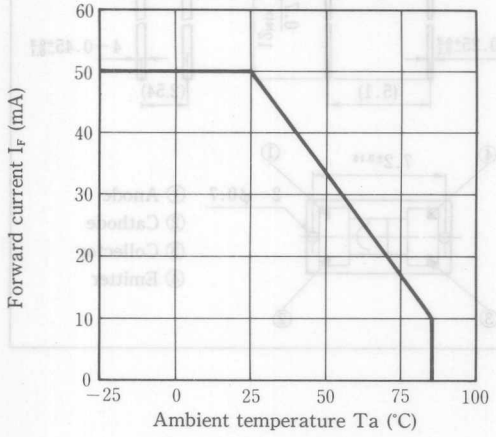


Fig. 2 Collector Power dissipation vs. Ambient Temperature

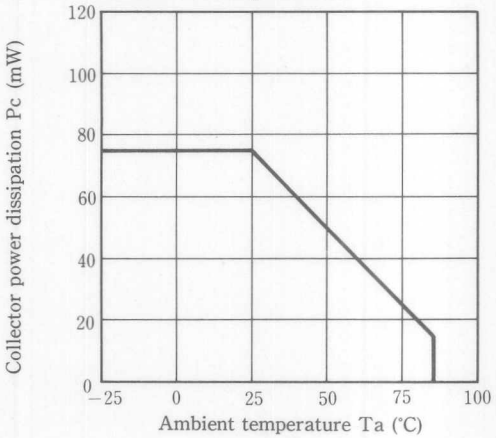


Fig. 3 Peak Forward Current vs. Duty Ratio

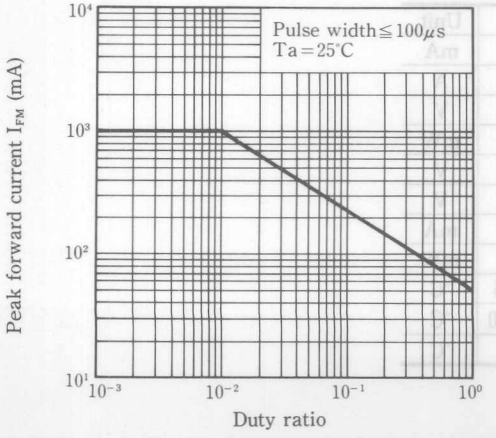


Fig. 4 Forward Current vs. Forward Voltage

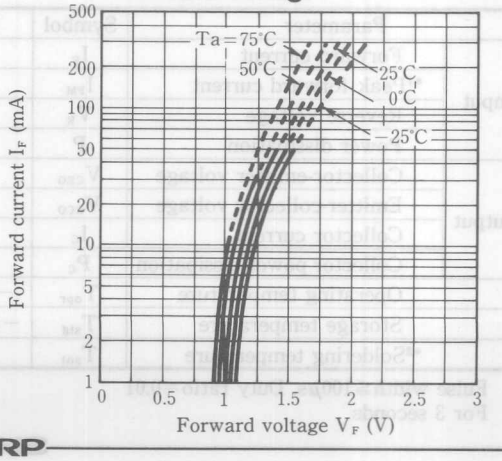


Fig. 5 Collector Current vs. Forward Current

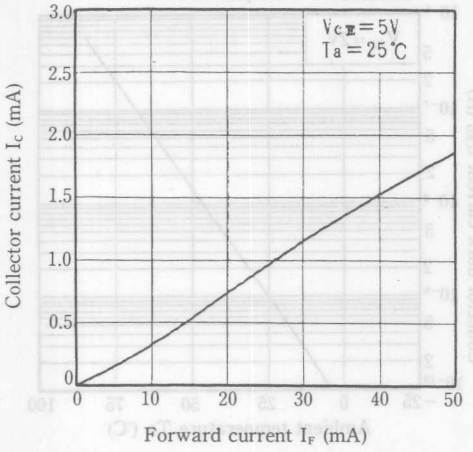


Fig. 6 Collector Current vs. Collector-emitter Voltage

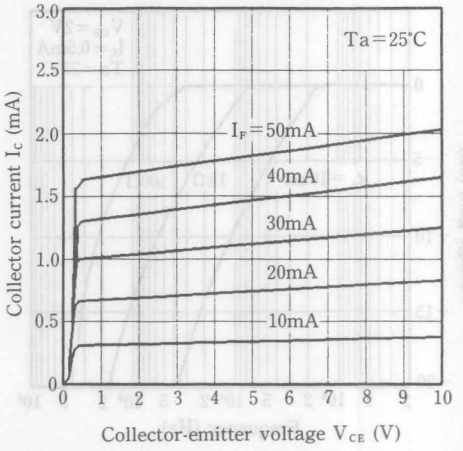


Fig. 7 Collector Current vs. Ambient Temperature

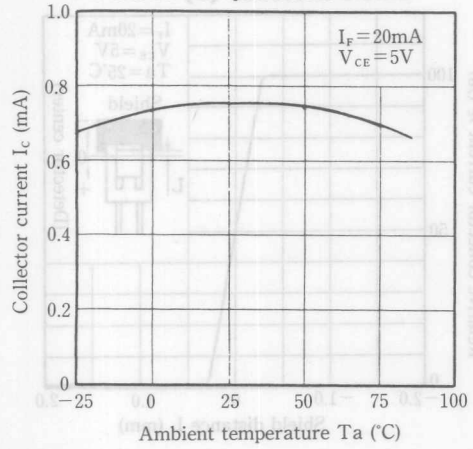


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

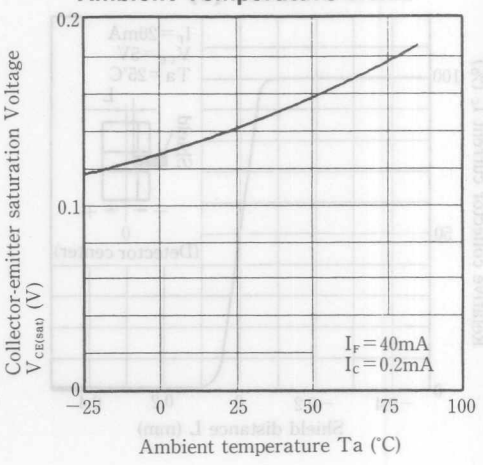
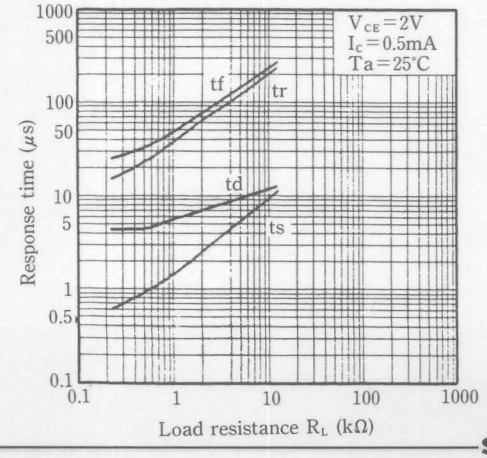
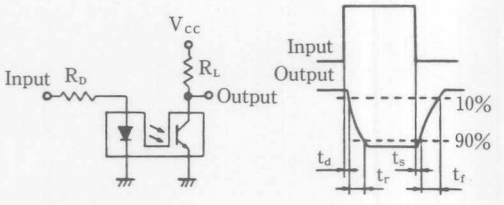


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

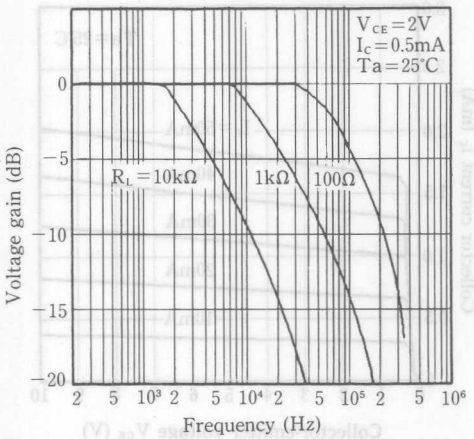


Fig. 11 Collector Dark Current vs. Ambient Temperature

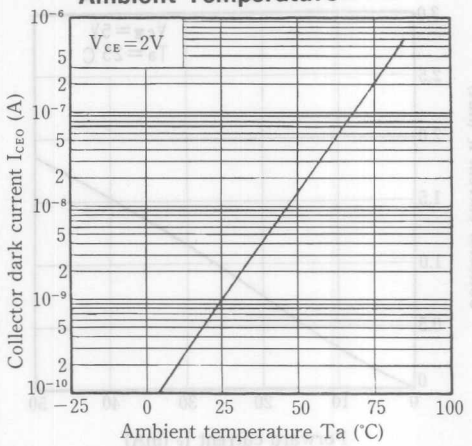


Fig. 12 Relative Collector Current vs. Shield Distance (1)

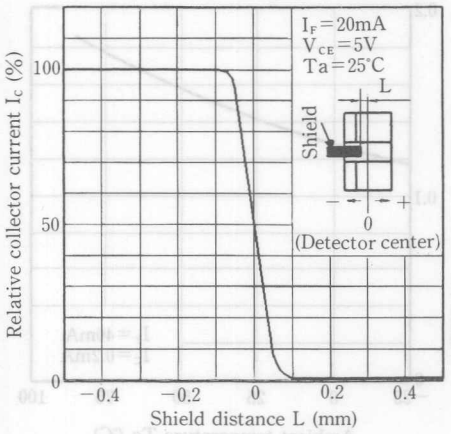
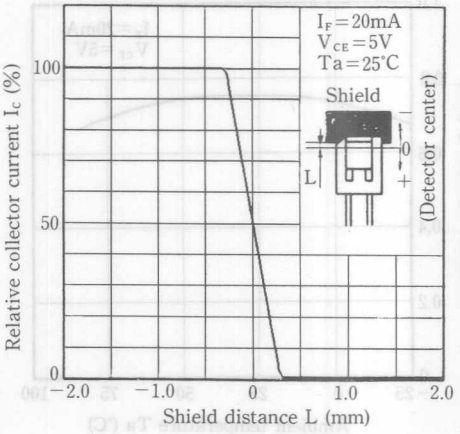


Fig. 13 Relative Collector Current vs. Shield Distance (2)



GP1S58 Compact Potointerrupter

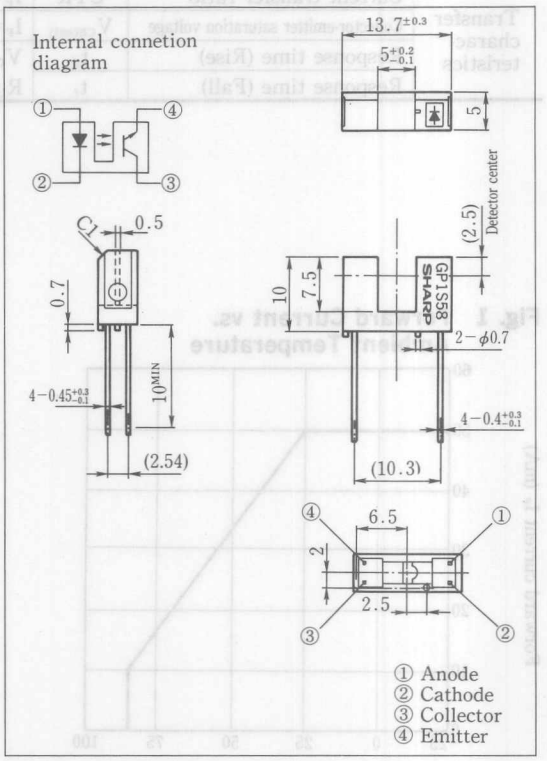
■ Features

1. Compact type
2. High sensing accuracy (Slilt width : 0.5mm)
3. PWB mounting type
4. With positioning pin

■ Applications

1. OA equipment, such as FDDs, printers, facsimiles
2. VCRs

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collecter-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collecter power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	2.5	—	75	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=40mA, I_C=0.5mA	—	—	0.4	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	3	15	μs
	Response time (Fall)	t_f	R_L=100Ω	—	4	20	μs

Fig. 1 Forward Current vs. Ambient Temperature

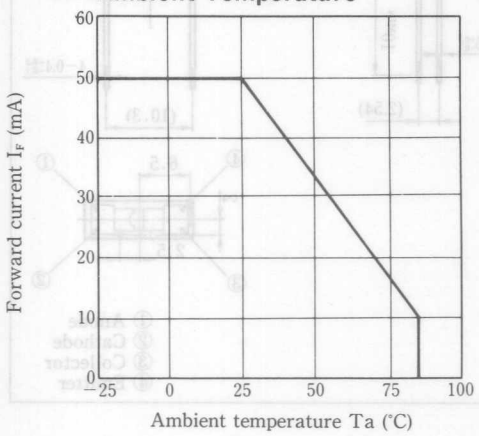


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

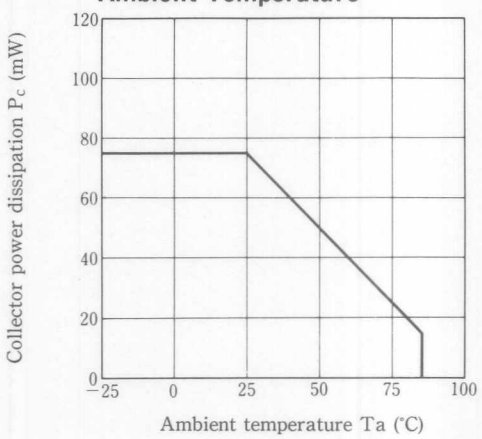


Fig. 3 Peak Forward Current vs. Duty Ratio

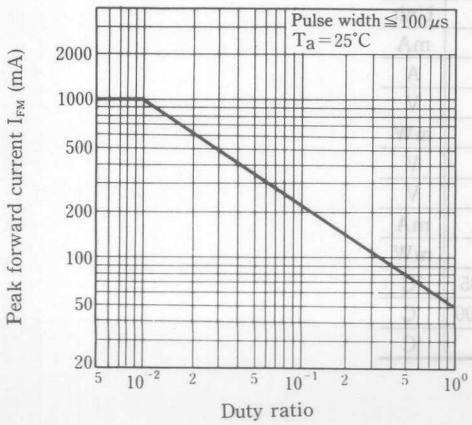


Fig. 4 Forward Current vs. Forward Voltage

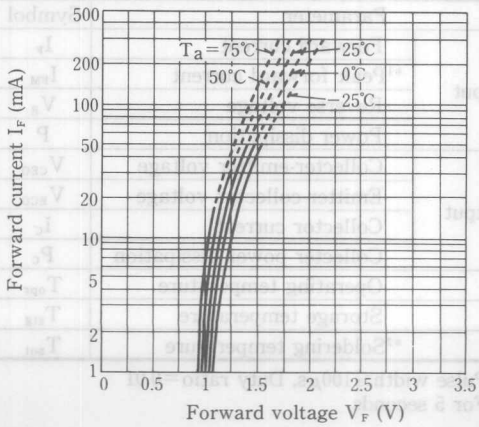


Fig. 5 Collector Current vs. Forward Current

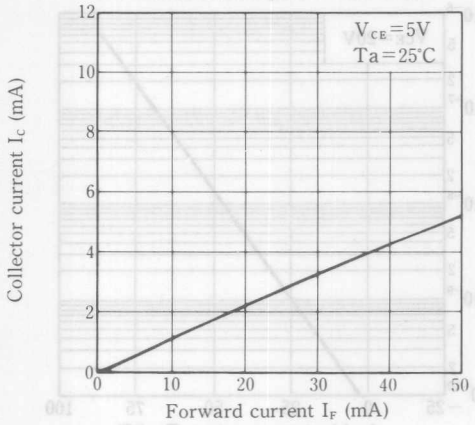


Fig. 6 Collector Current vs. Collector-emitter Voltage

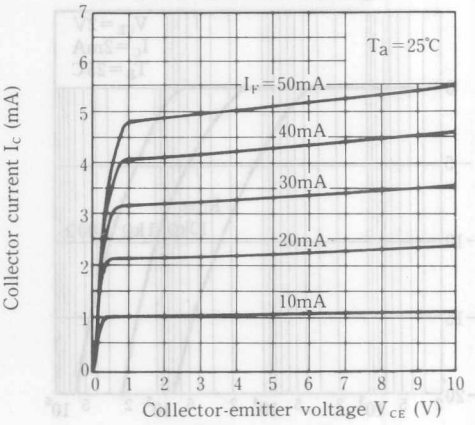


Fig. 7 Collector Current vs. Ambient Temperature

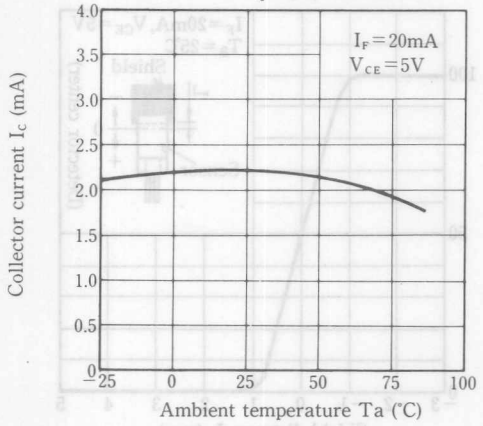


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

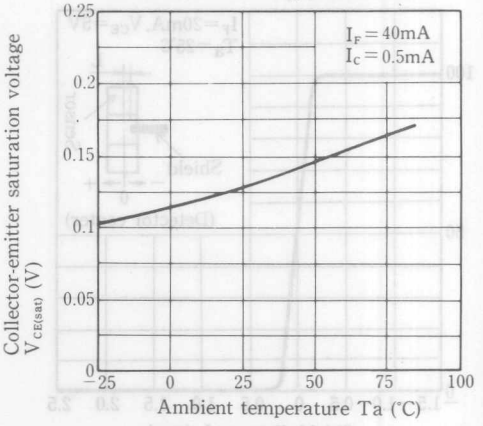
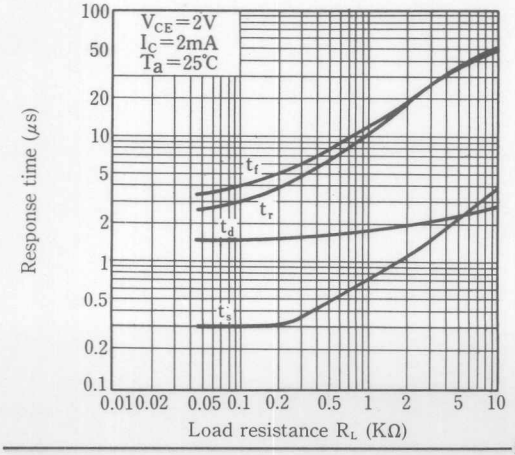
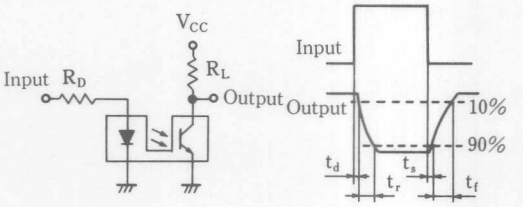


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

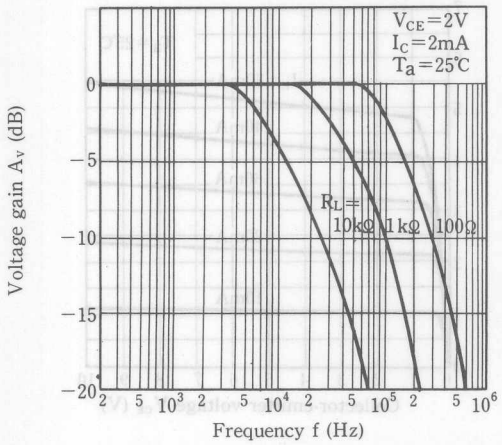


Fig. 11 Collector Dark Current vs. Ambient Temperature

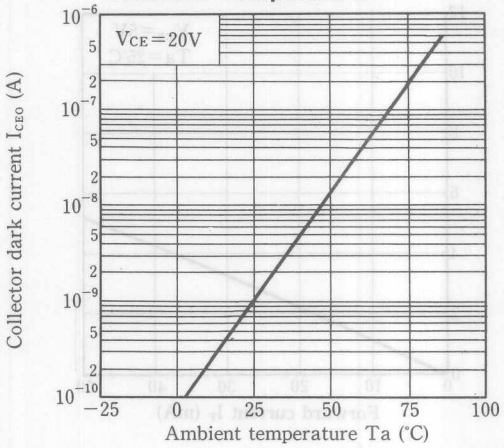


Fig. 12 Relative Collector Current vs. Shield Distance (1)

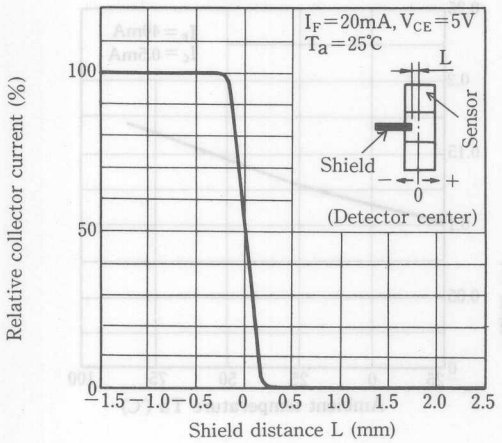
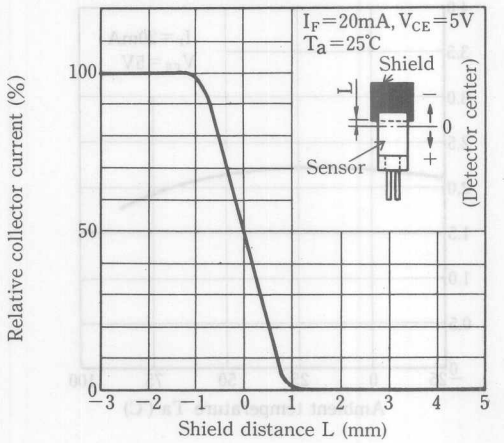


Fig. 13 Relative Collector Current vs. Shield Distance (2)



GP1L01/GP1L01F High Sensitivity Type Photointerrupter

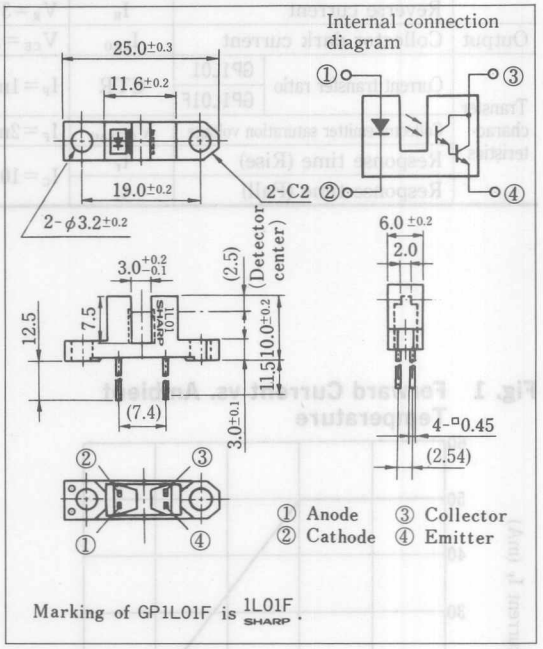
■ Features

1. High current transfer ratio
   GP1L01 CTR: MIN. 300%
   GP1L01F CTR: MIN. 250%
   } at I_F=1mA
2. Visible light cut-off type: GP1L01F

■ Applications

1. Record players, cassette decks
2. Copiers, printers, facsimiles
3. Telephone sets
4. Fan heaters, electronic sewing machines

■ Outline Dimensions (Unit : mm)



7

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage		V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Collector dark current		I_{CEO}	V_{CE}=10V	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	GP1L01	CTR	I_F=1mA, V_{CE}=2V	300	1,000	—	%
		GP1L01F			250	1,000	—	%
	Collector-emitter saturation voltage		$V_{CE(sat)}$	I_F=2mA, I_C=1.5mA	—	—	1.0	V
	Response time (Rise)		t_r	I_C=10mA, V_{CE}=2V, R_L=100Ω	—	80	400	μs
	Response time (Fall)		t_f		—	70	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

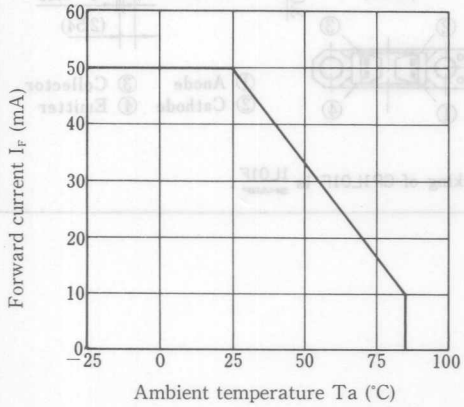


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

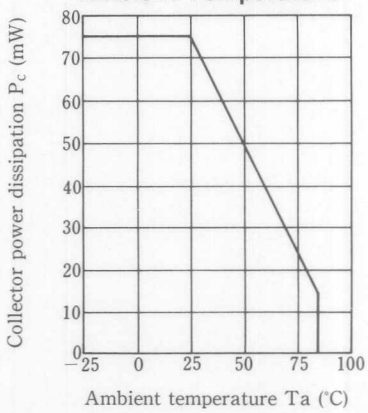


Fig. 3 Peak Forward Current vs. Duty Ratio

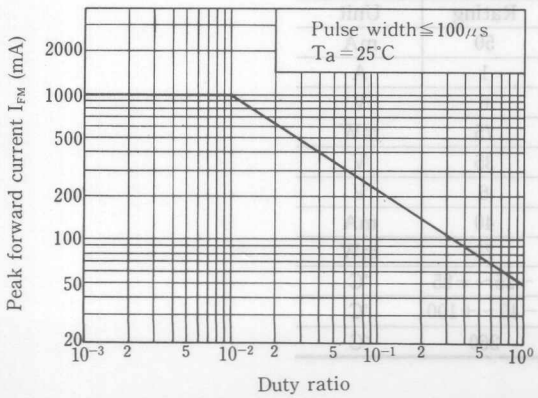


Fig. 4 Forward Current vs. Forward Voltage

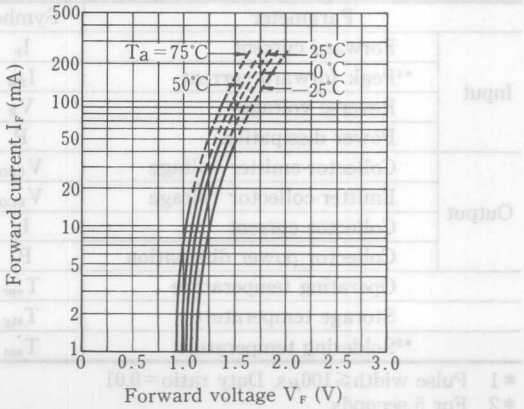


Fig. 5 Collector Current vs. Forward Current

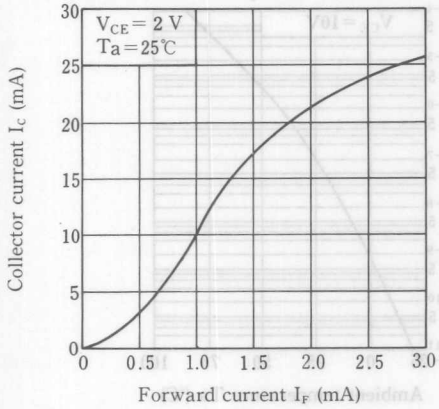


Fig. 6 Collector Current vs. Collector-emitter Voltage

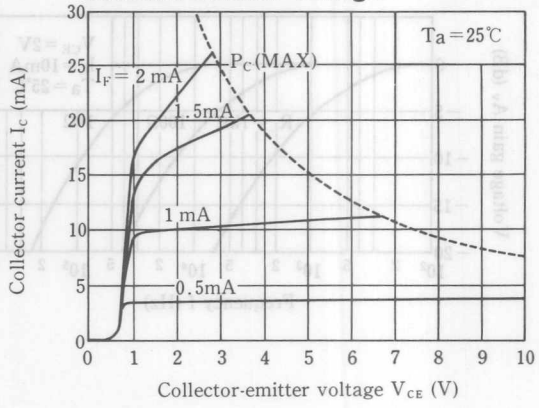


Fig. 7 Collector Current vs. Ambient Temperature

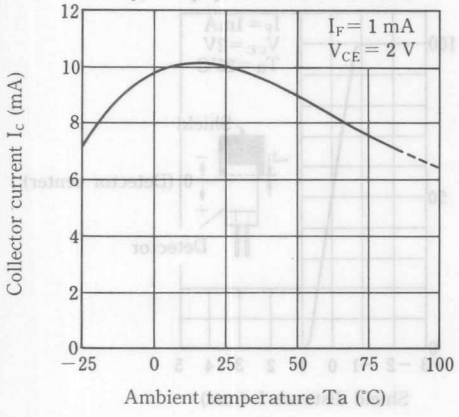


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

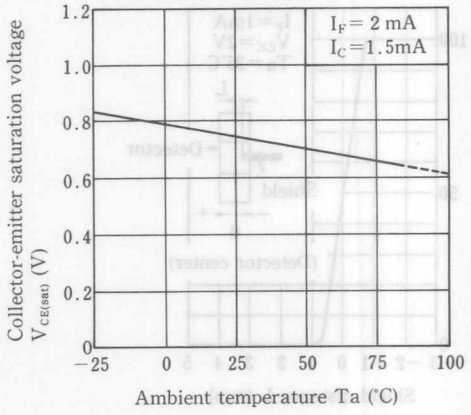
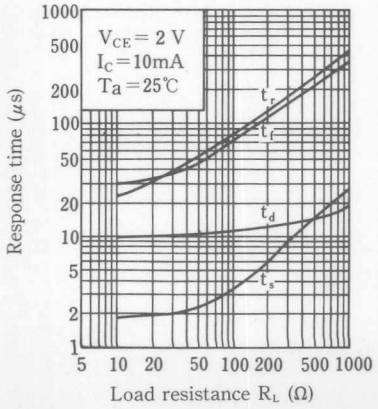
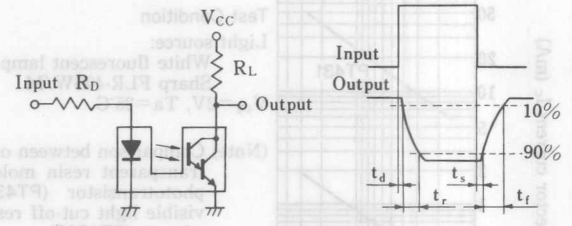


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time



7

Fig. 10 Frequency Response

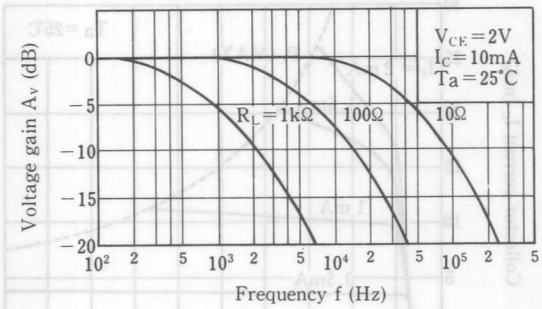


Fig. 11 Collector Dark Current vs. Ambient Temperature

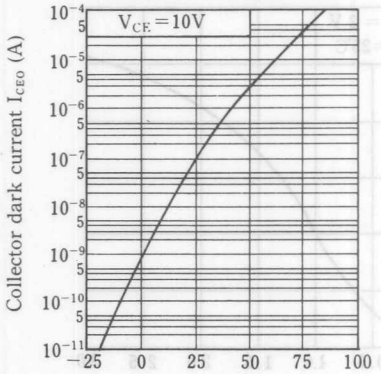


Fig. 12 Relative Collector Current vs. Shield Distance (1)

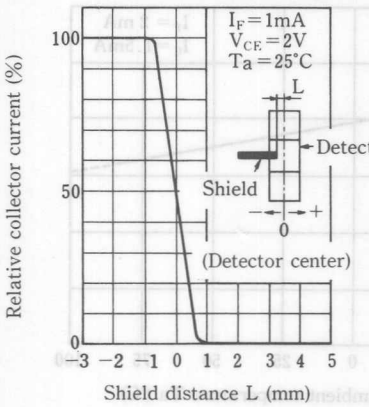


Fig. 13 Relative Collector Current vs. Shield Distance (2)

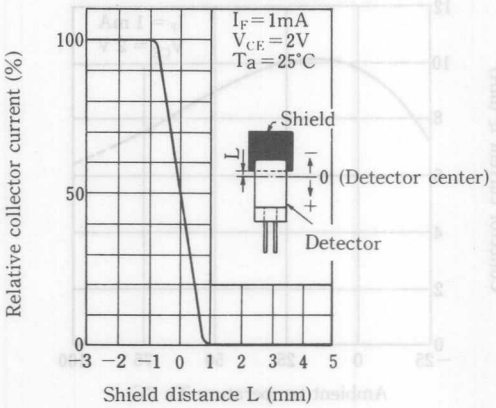
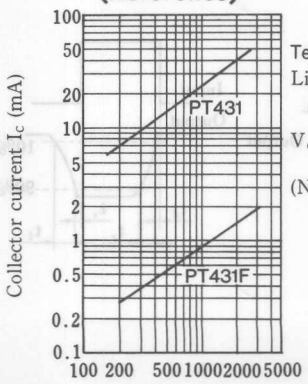


Fig. 14 Collector Current vs. Illuminance (Reference)



Test Condition
Light source:
White fluorescent lamp
Sharp FLR-40SW/M
V_{CE} = 2V, Ta = 25°C

(Note) Comparison between outputs of transparent resin molded type phototransistor (PT431) and visible light cut-off resin molded type (PT431F)

GP1L02 Photointerrupter

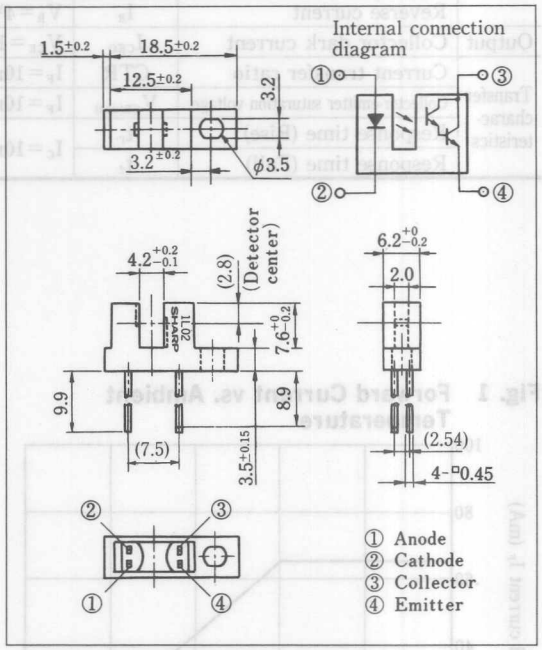
■ Features

1. High current transfer ratio
   (CTR: MIN. 20% at I_F=10mA)
2. Either side installation type package

■ Applications

1. VCRs, record players, cassette decks
2. Fan heaters, electronic sewing machines, knitting machines
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	65	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	100	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	—	4.0	V
	Reverse current	I_R	V_R=4V	—	—	20	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V, I_F=0	—	—	4×10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=10mA, V_{CE}=2V	20	—	150	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=10mA, I_C=0.5mA	—	—	1.2	V
	Response time (Rise)	t_r	I_C=10mA, V_{CE}=2V, R_L=100Ω	—	130	520	μs
	Response time (Fall)	t_f		—	100	400	μs

Fig. 1 Forward Current vs. Ambient Temperature

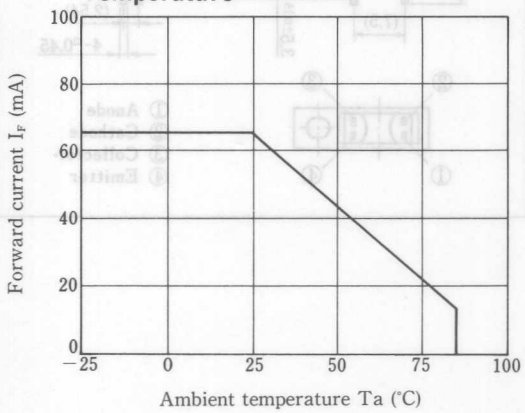


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

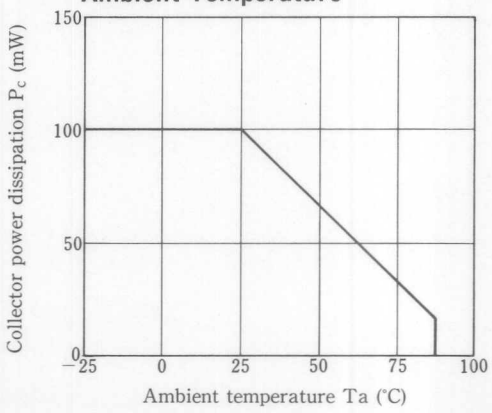


Fig. 3 Peak Forward Current vs. Duty Ratio

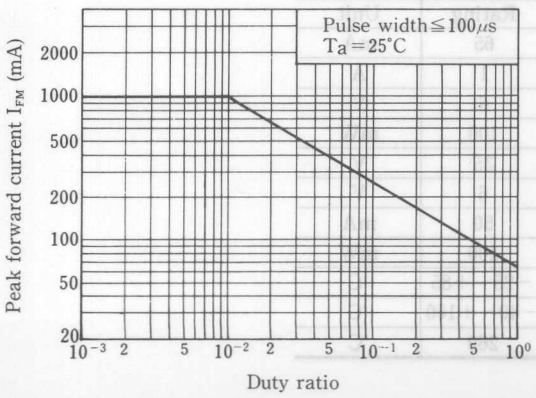


Fig. 4 Forward Current vs. Forward Voltage

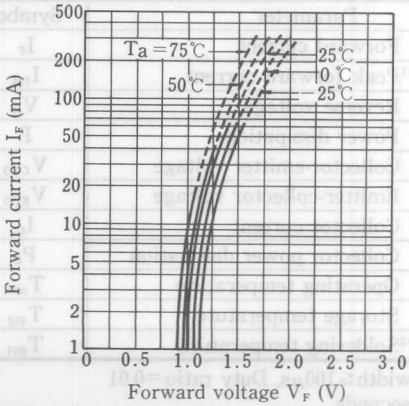


Fig. 10 Frequency Response

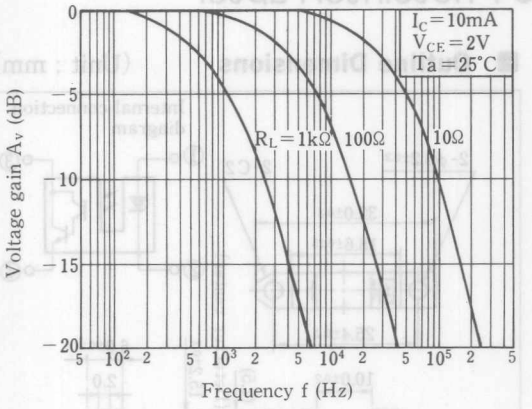


Fig. 11 Collector Dark Current vs. Ambient Temperature

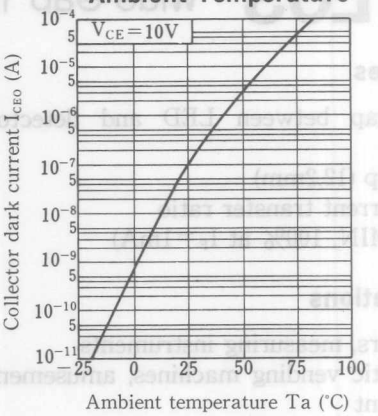


Fig. 12 Relative Collector Current vs. Shield Distance (1)

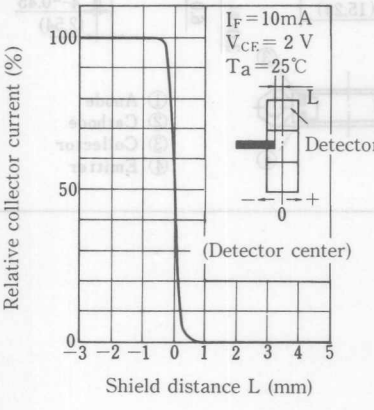
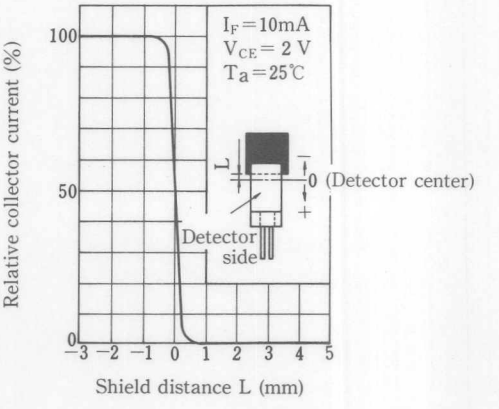


Fig. 13 Relative Collector Current vs. Shield Distance (2)



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GP1L03 Wide Gap Type Photointerrupter

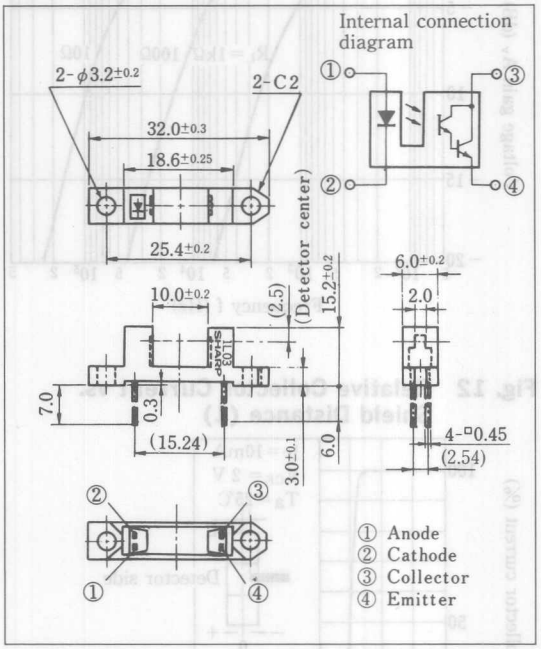
■ Features

1. Wide gap between LED and detector (10mm)
2. Deep gap (12.2mm)
3. High current transfer ratio (CTR: MIN. 100% at I_F=1mA)

■ Applications

1. Analyzers, measuring instruments
2. Automatic vending machines, amusement equipment
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	100	—	2,000	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=0.5mA	—	—	1.0	V
	Response time (Rise)	t_r	I_C=10mA, V_{CE}=2V, R_L=100Ω	—	80	400	μs
	Response time (Fall)	t_f		—	70	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

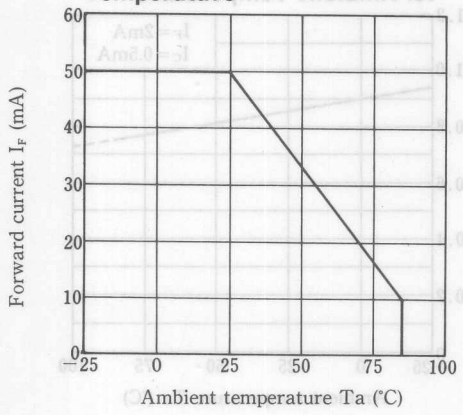


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

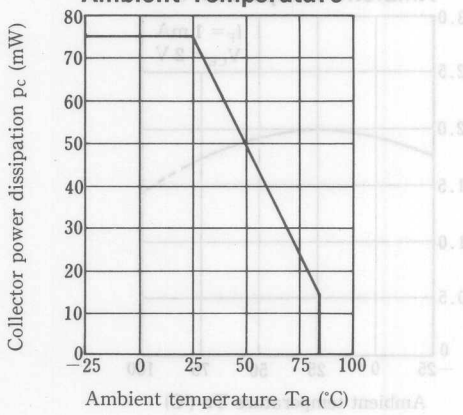


Fig. 3 Peak Forward Current vs. Duty Ratio

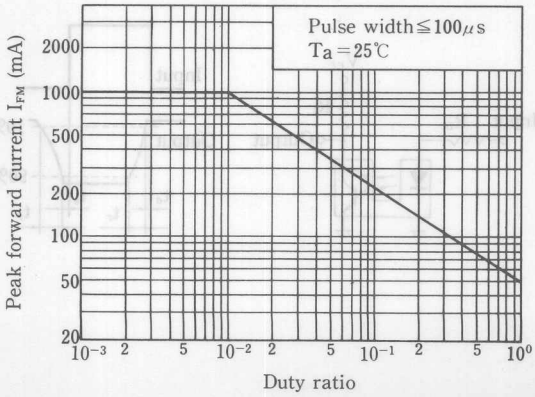
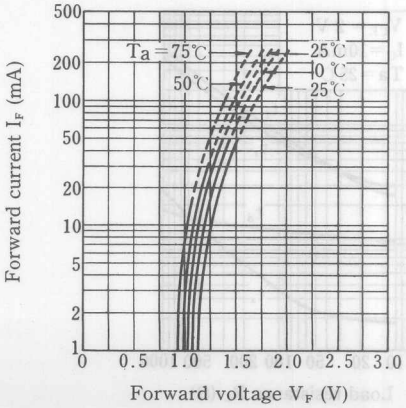


Fig. 4 Forward Current vs. Forward Voltage



7

Fig. 5 Collector Current vs. Forward Current

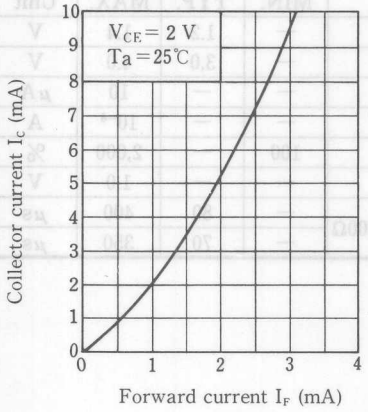


Fig. 6 Collector Current vs. Collector-emitter Voltage

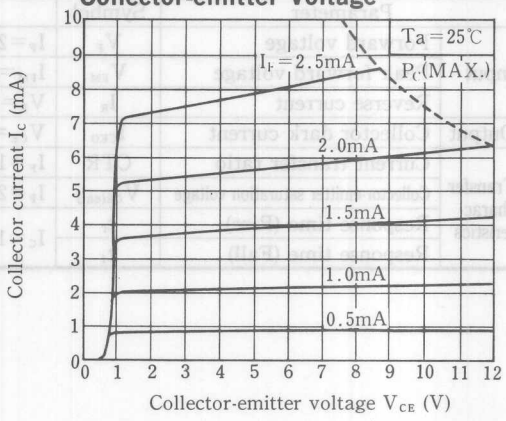


Fig. 7 Collector Current vs. Ambient Temperature

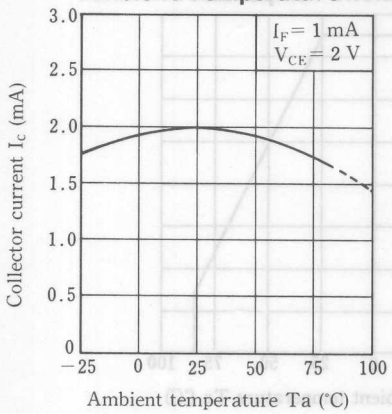


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

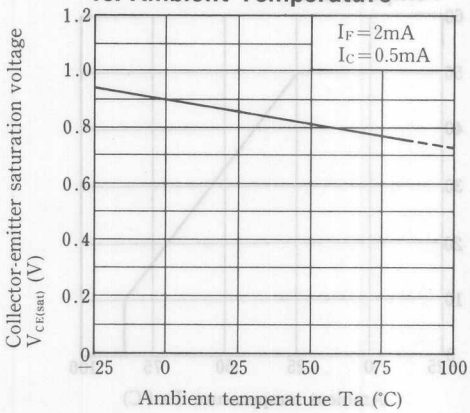
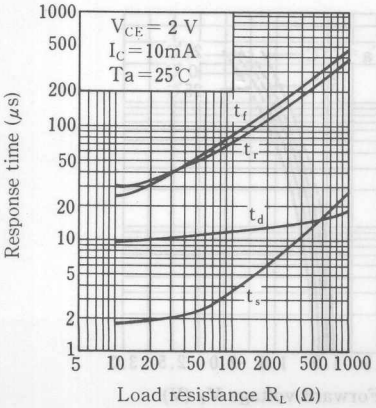


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

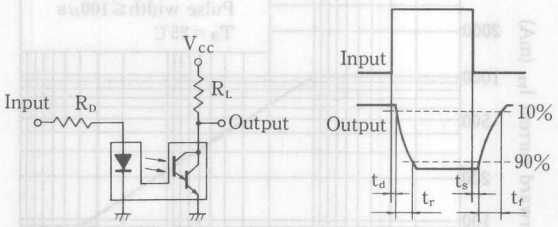


Fig. 10 Frequency Response

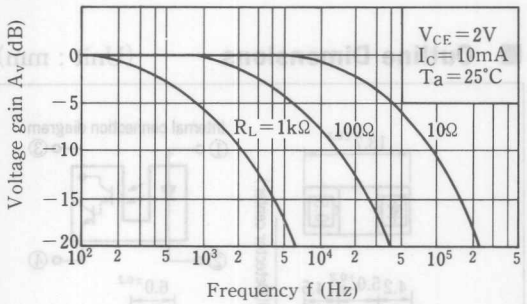


Fig. 11 Collector Dark Current vs. Ambient Temperature

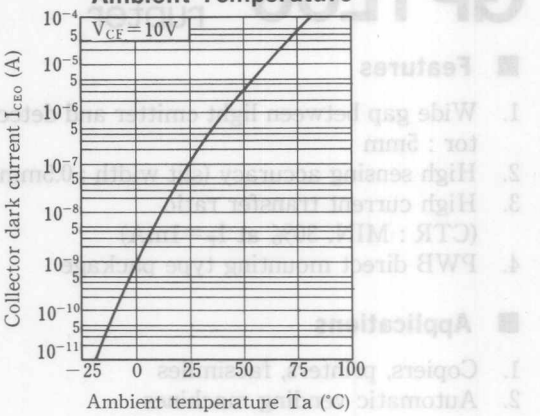


Fig. 12 Relative Collector Current vs. Shield Distance (1)

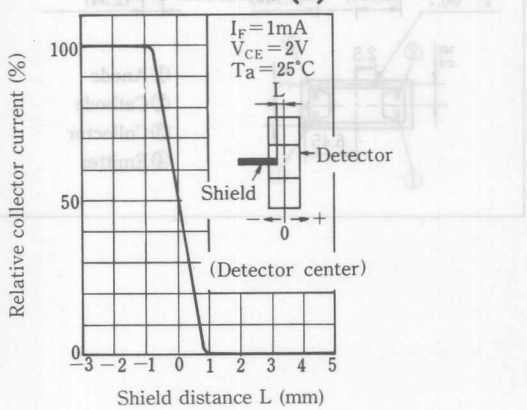
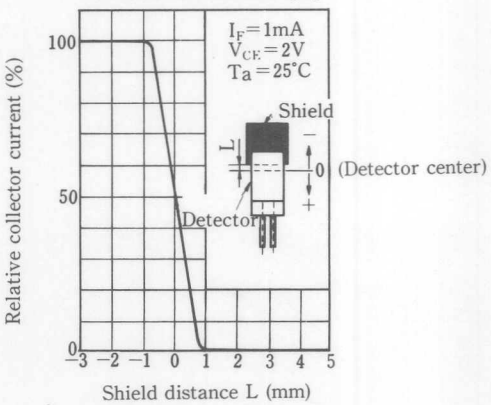


Fig. 13 Relative Collector Current vs. Shield Distance (2)



7

GP1L06 Wide Gap Type, High Sensitivity Photointerrupter

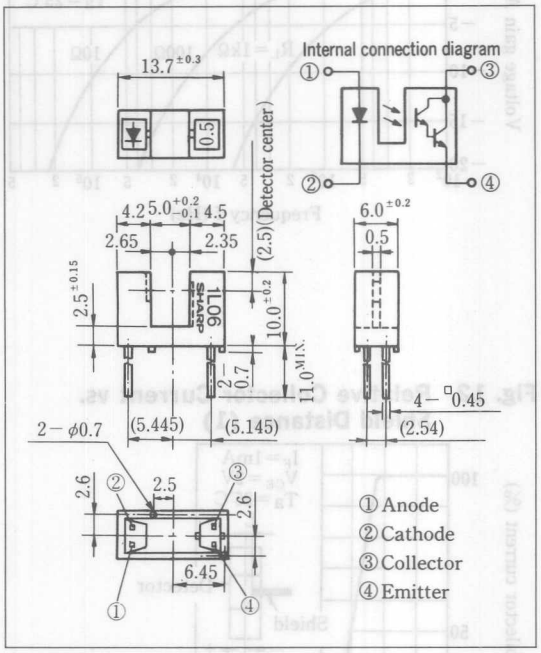
■ Features

1. Wide gap between light emitter and detector : 5mm
2. High sensing accuracy (slit width : 0.5mm)
3. High current transfer ratio (CTR : MIN. 30% at I_F=1mA)
4. PWB direct mounting type package

■ Applications

1. Copiers, printers, facsimiles
2. Automatic vending machines

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	30	—	2,000	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=0.3mA	—	—	1.0	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	130	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	100	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

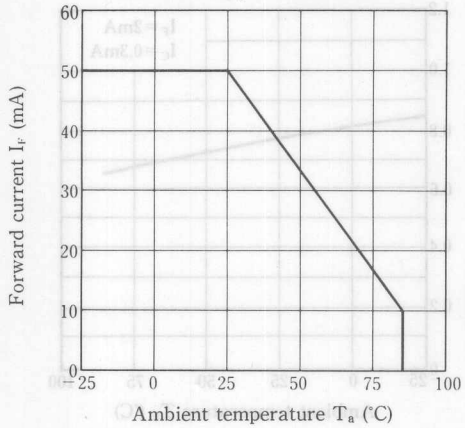


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

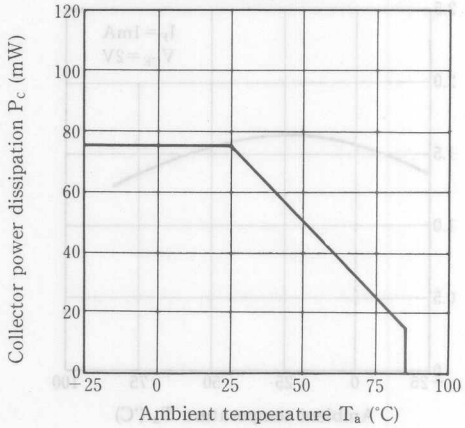


Fig. 3 Peak Forward Current vs. Duty Ratio

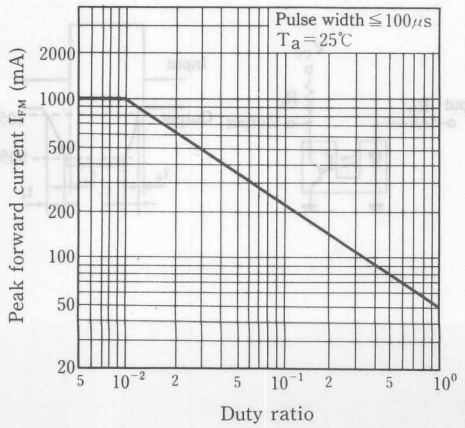
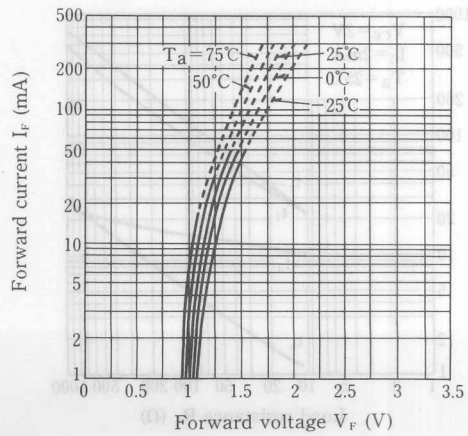


Fig. 4 Forward Current vs. Forward Voltage



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Fig. 5 Collector Current vs. Forward Current

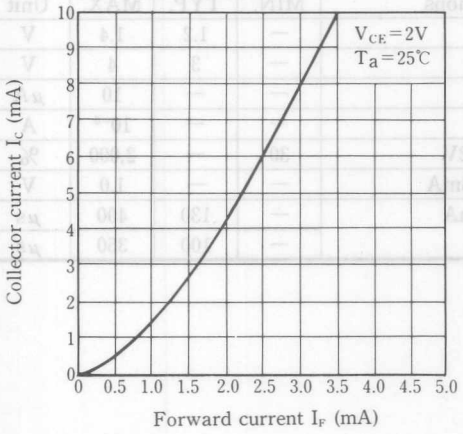


Fig. 6 Collector Current vs. Collector-emitter Voltage

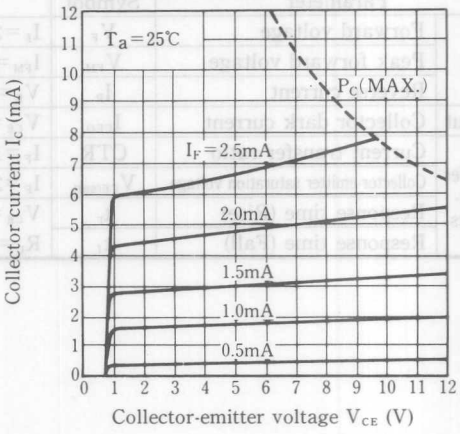


Fig. 7 Collector Current vs. Ambient Temperature

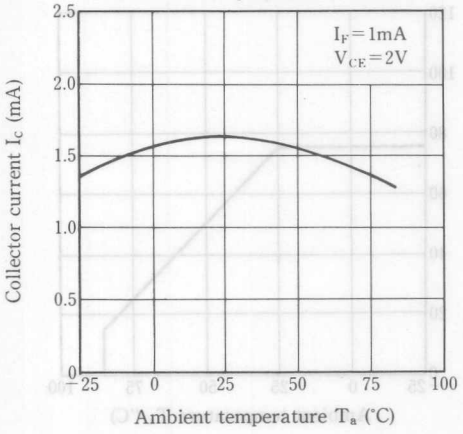


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

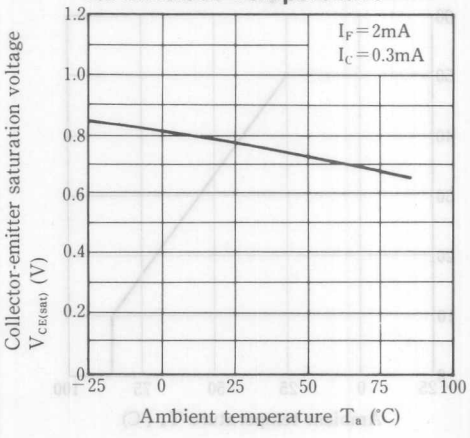
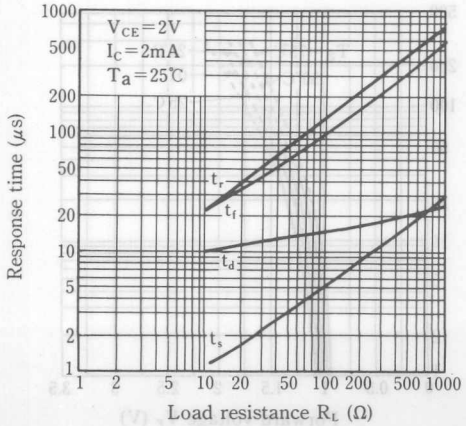


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

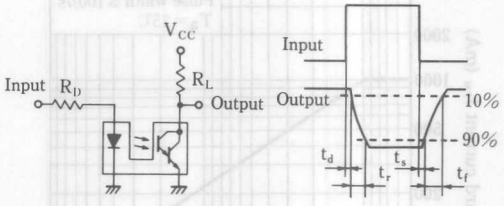


Fig. 10 Frequency Response

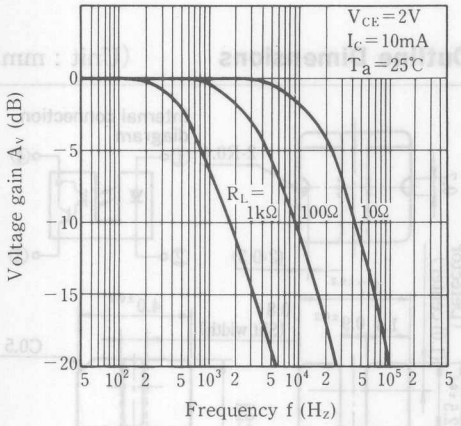


Fig. 11 Collector Dark Current vs. Ambient Temperature

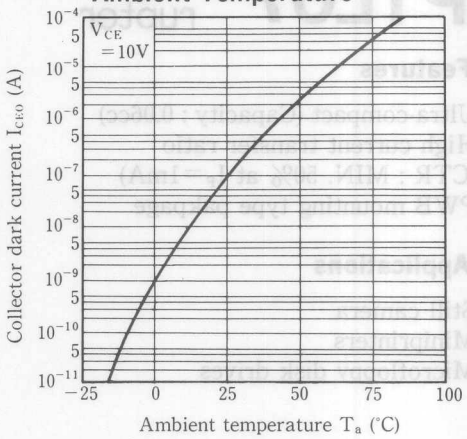


Fig. 12 Relative Collector Current vs. Shield Distance (1)

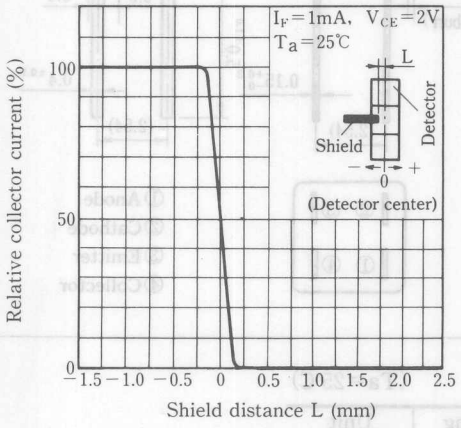
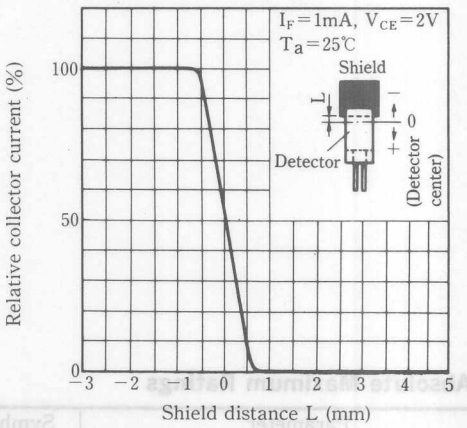


Fig. 13 Relative Collector Current vs. Shield Distance (2)



7

GP1L07 Subminiature, High Sensitivity Photointerrupter

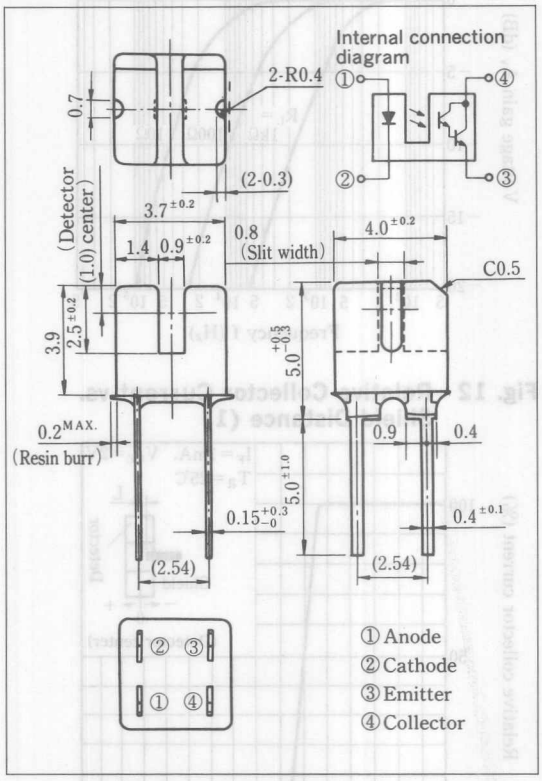
■ Features

1. Ultra-compact (Capacity : 0.06cc)
2. High current transfer ratio
   (CTR : MIN. 50% at I_F=1mA)
3. PWB mounting type pakpage

■ Applications

1. Still camera
2. Miniprinters
3. Microfloppy disk drives

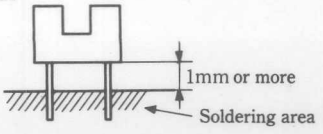
■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emiter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 5 seconds



■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	50	—	2,000	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=0.5mA	—	—	1.0	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=10mA	—	80	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	70	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

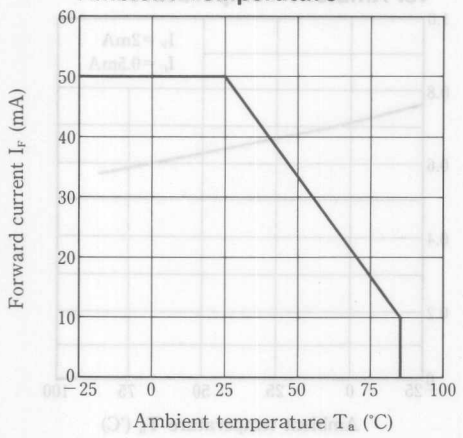


Fig. 2 Power Dissipation vs. Ambient Temperature

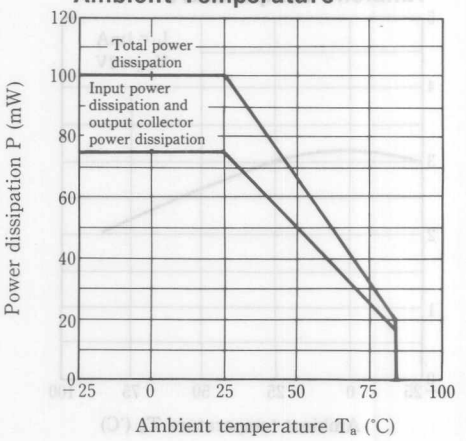


Fig. 3 Peak Forward Current vs. Duty Ratio

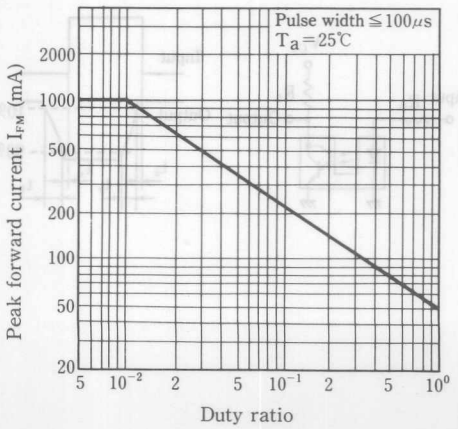
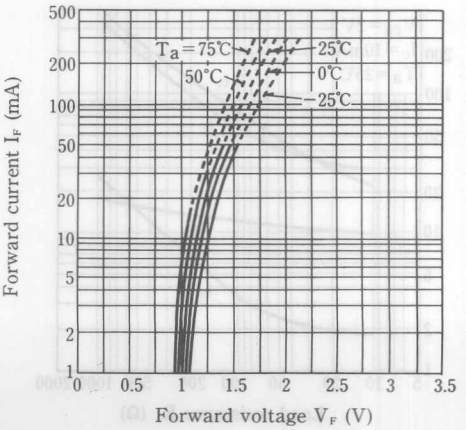


Fig. 4 Forward Current vs. Forward Voltage



7

Fig. 5 Collector Current vs. Forward Current

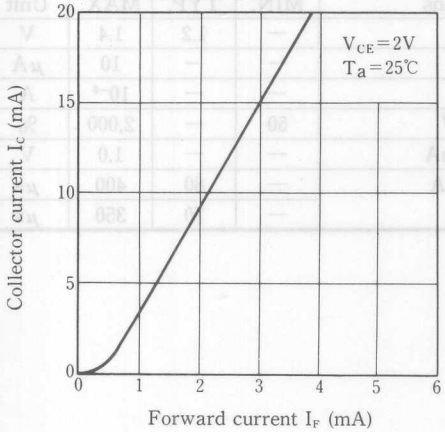


Fig. 6 Collector Current vs. Collector-emitter Voltage

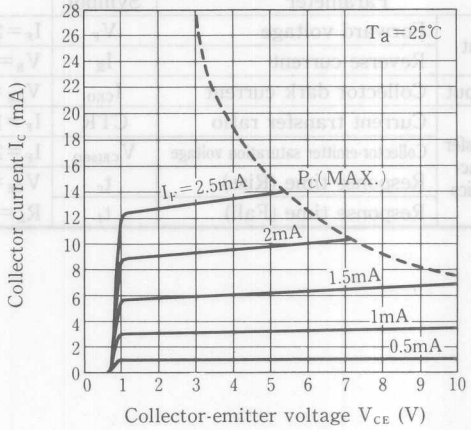


Fig. 7 Collector Current vs. Ambient Temperature

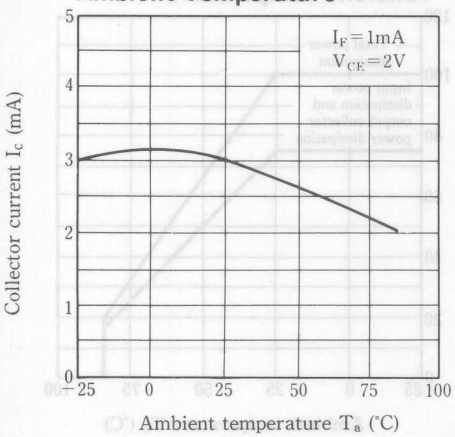


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

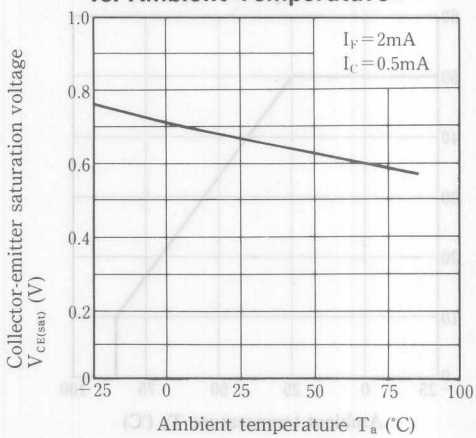
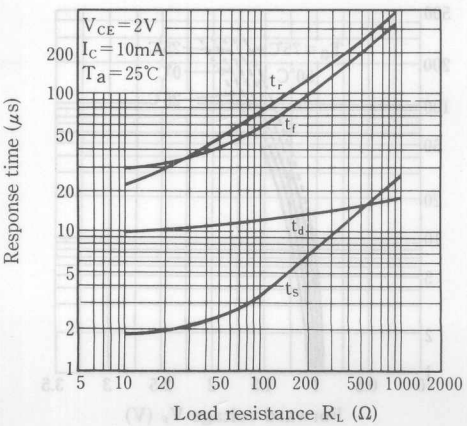


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

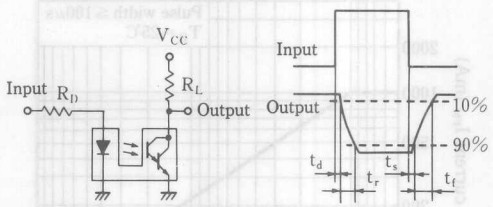


Fig. 10 Collector Dark Current vs. Ambient Temperature

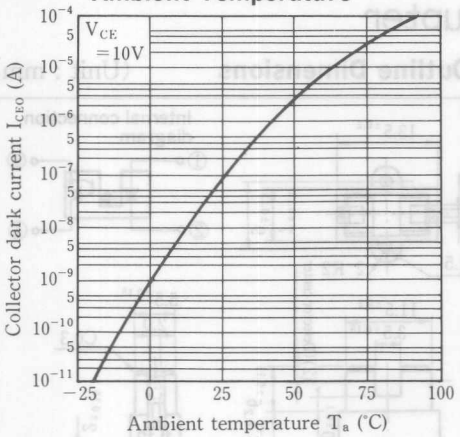


Fig. 11 Relative Collector Current vs. Shield Distance (1)

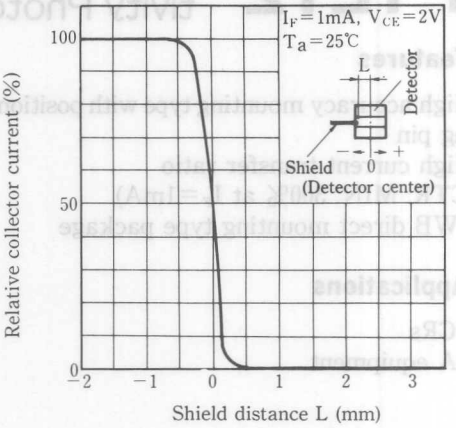
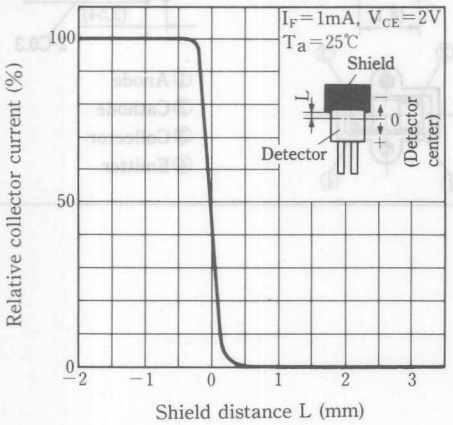


Fig. 12 Relative Collector Current vs. Shield Distance (2)



7

GP1L12 High Accuracy Mounting Type, High Sensitivity Photointerrupter

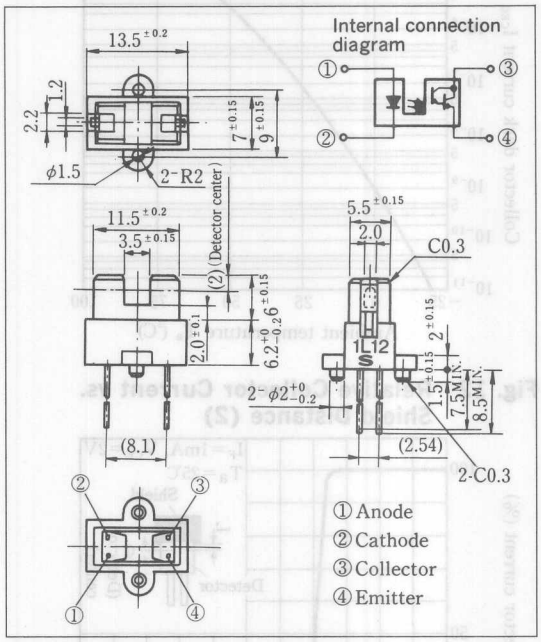
■ Features

1. High accuracy mounting type with positioning pin
2. High current transfer ratio (CTR: MIN. 300% at I_F=1mA)
3. PWB direct mounting type package

■ Applications

1. VCRs
2. OA equipment

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	300	—	3,700	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=1.5mA	—	—	1.0	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=10mA	—	80	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	70	350	μs

(Note)
It should be taken into consideration in your application that vibrations may cause the collector current to vary in the range of up to 20% due to its structural design.

Fig. 1 Forward Current vs. Ambient Temperature

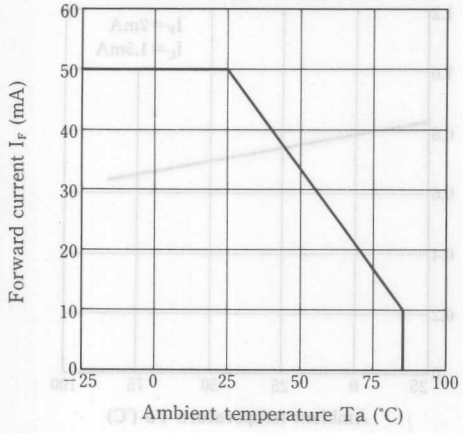


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

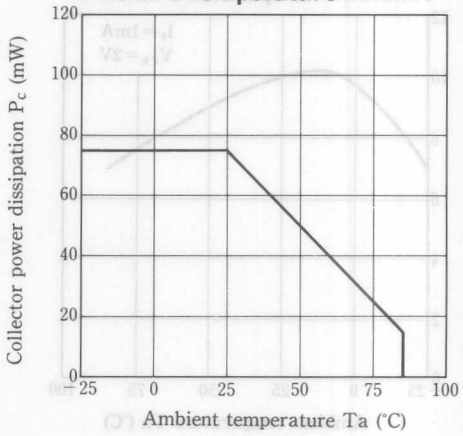


Fig. 3 Peak Forward Current vs. Duty Ratio

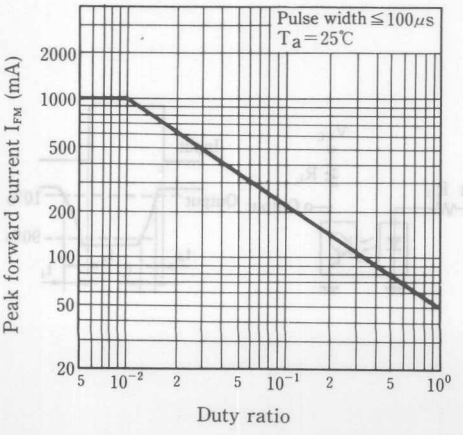
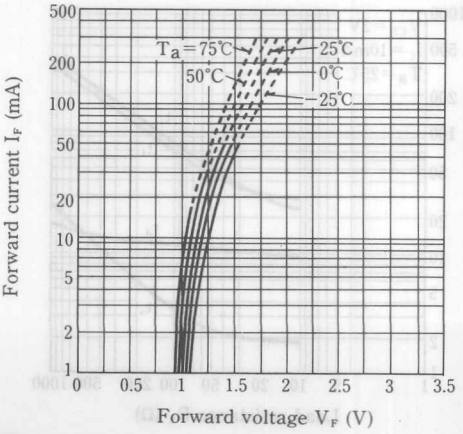


Fig. 4 Foward Current vs. Forward Voltage



7

Fig. 5 Collector Current vs. Forward Current

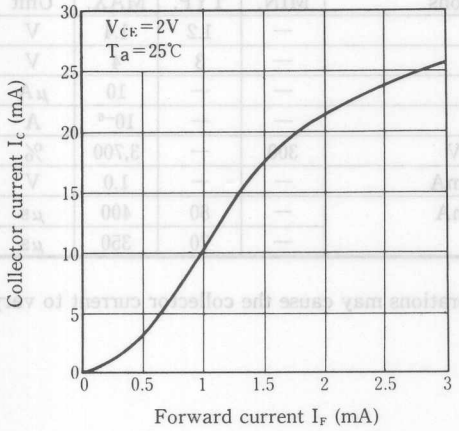


Fig. 6 Collector Current vs. Collector-emitter Voltage

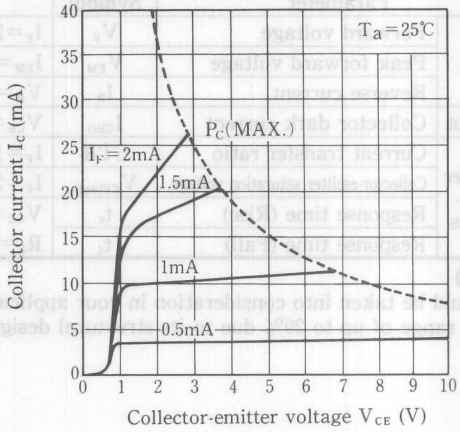


Fig. 7 Collector Current vs. Ambient Temperature

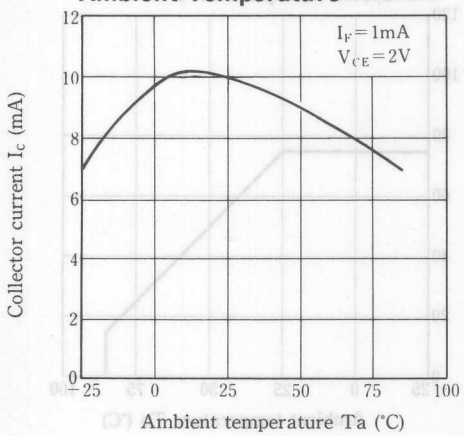


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

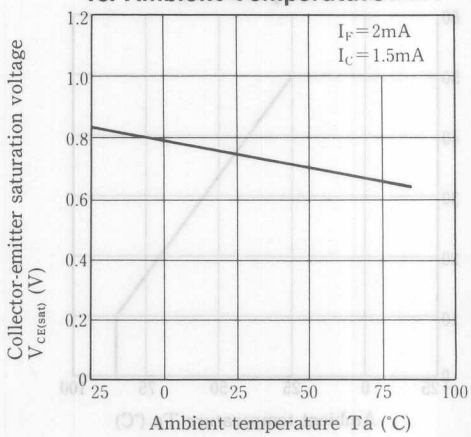
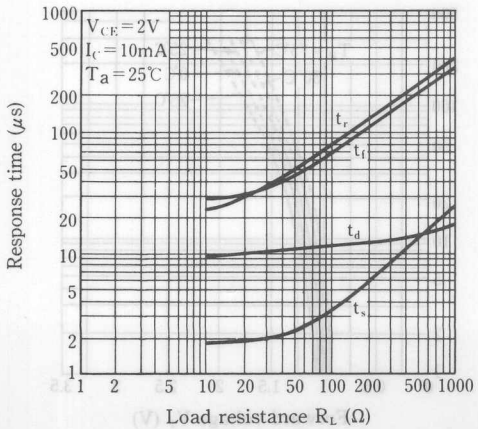


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

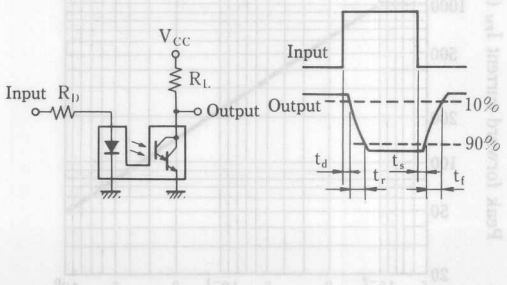


Fig. 10 Frequency Response

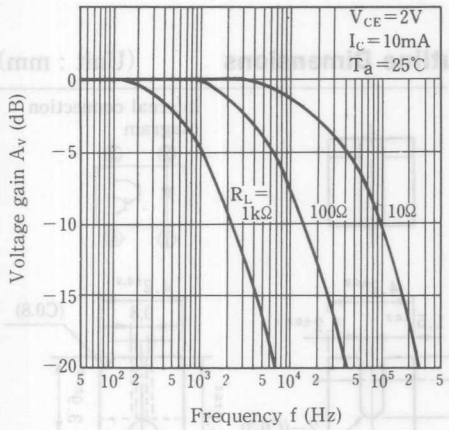


Fig. 11 Collector Dark Current vs. Ambient Temperature

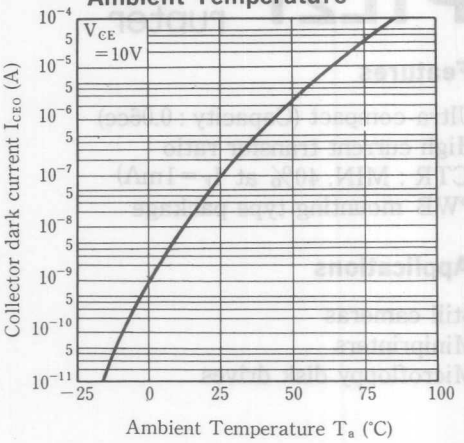


Fig. 12 Relative Collector Current vs. Shield Distance (1)

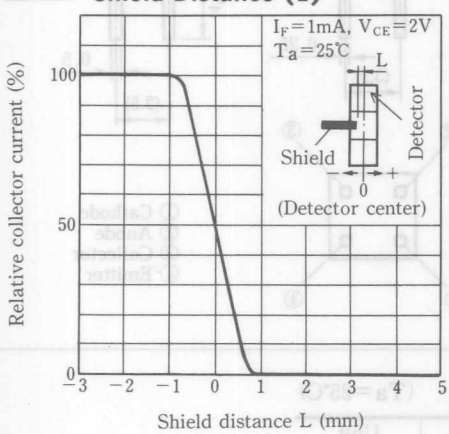
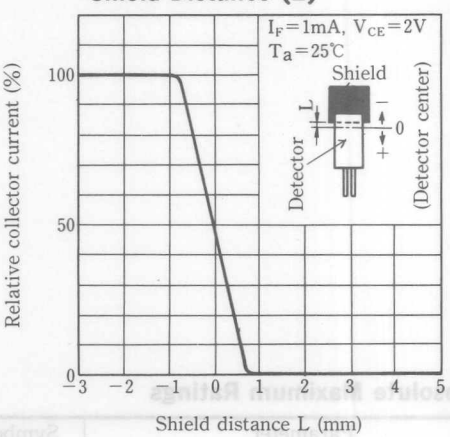


Fig. 13 Relative Collector Current vs. Shield Distance (2)



7

GP1L21 Subminiature, High Sensitivity Photointerrupter

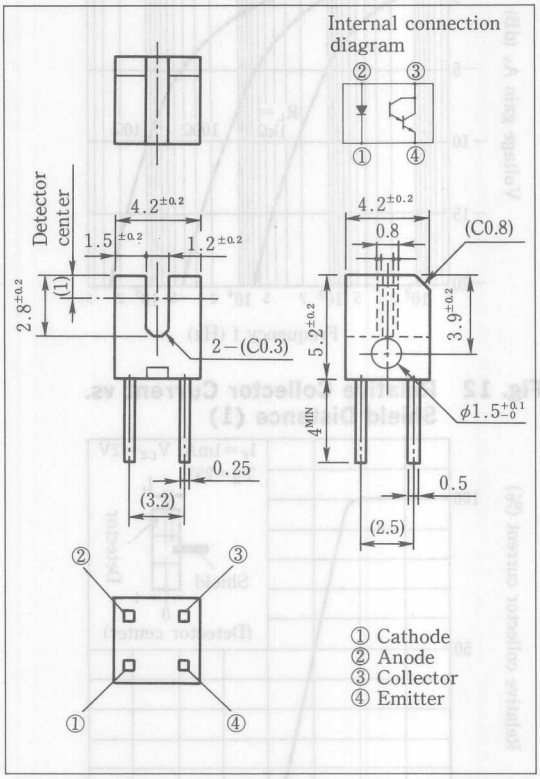
■ Features

1. Ultra-compact (Capacity : 0.06cc)
2. High current transfer ratio (CTR : MIN. 40% at I_F=1mA)
3. PWB mounting type package

■ Applications

1. Still cameras
2. Miniprinters
3. Microfloppy disk drives

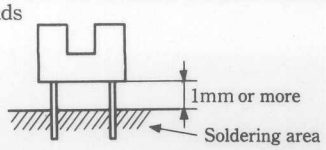
■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 5 seconds



■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-5}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	40	—	1,400	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=0.4mA	—	—	1.0	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=10mA	—	80	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	70	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

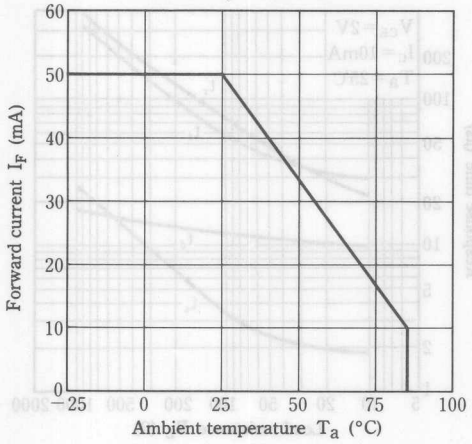


Fig. 2 Power Dissipation vs. Ambient Temperature

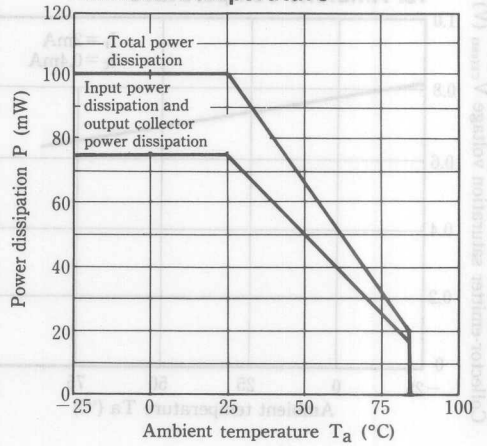


Fig. 3 Forward Current vs. Forward Voltage

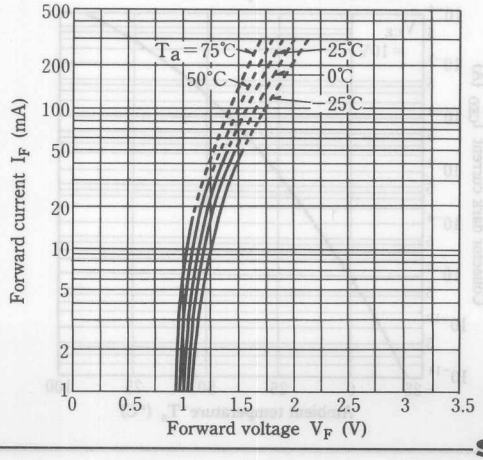
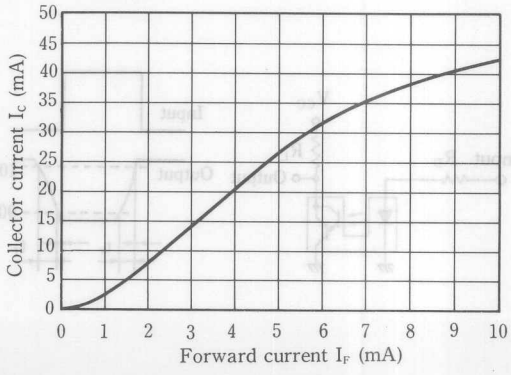


Fig. 4 Collector Current vs. Forward Current



7

Fig. 5 Collector Current vs. Collector-emitter Voltage

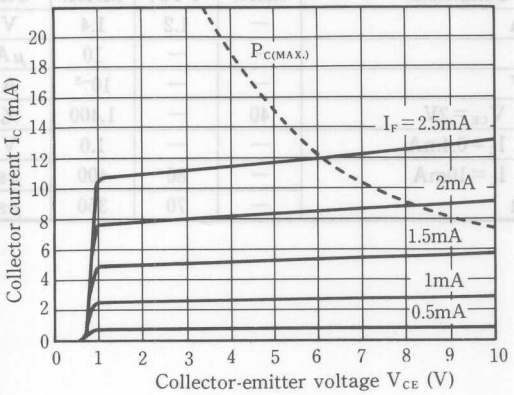


Fig. 6 Collector Current vs. Ambient Temperature

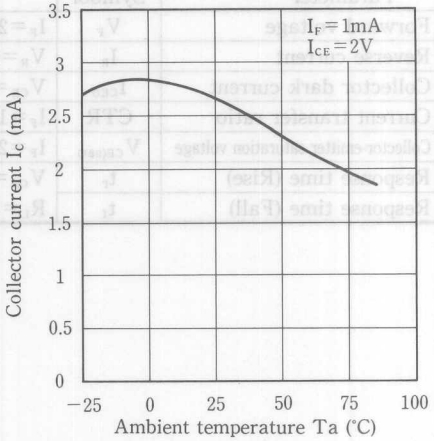


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

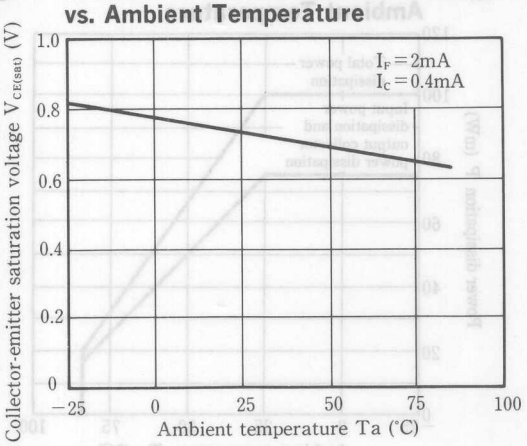
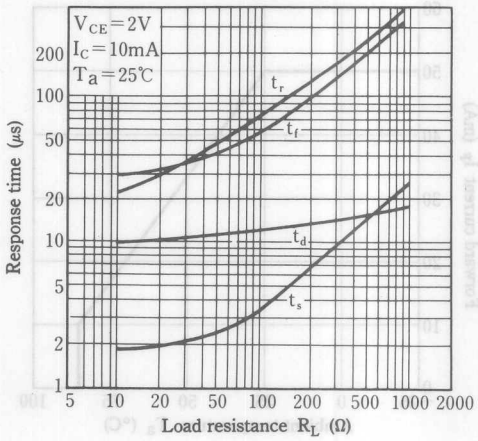


Fig. 8 Response Time vs. Load Resistance



Test Circuit for Response Time

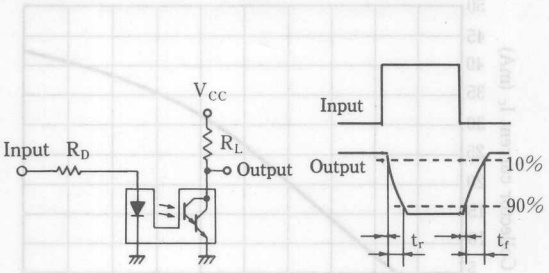


Fig. 9 Collector Dark Current vs. Ambient Temperature

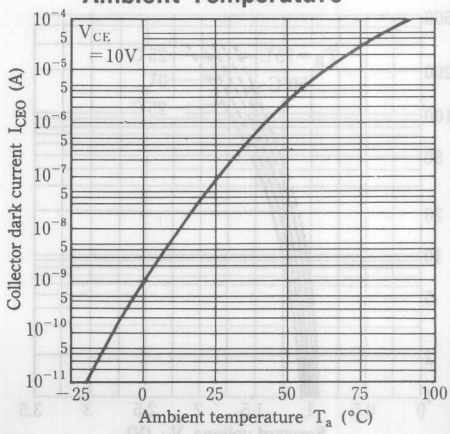


Fig. 10 Relative Collector Current vs. Shield Distance (1)

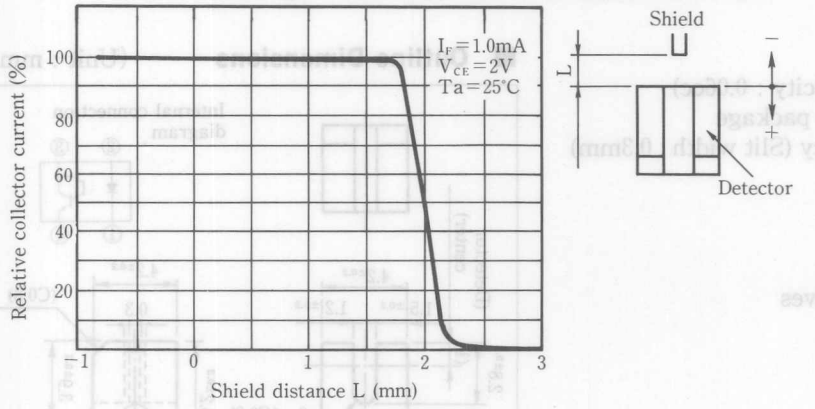
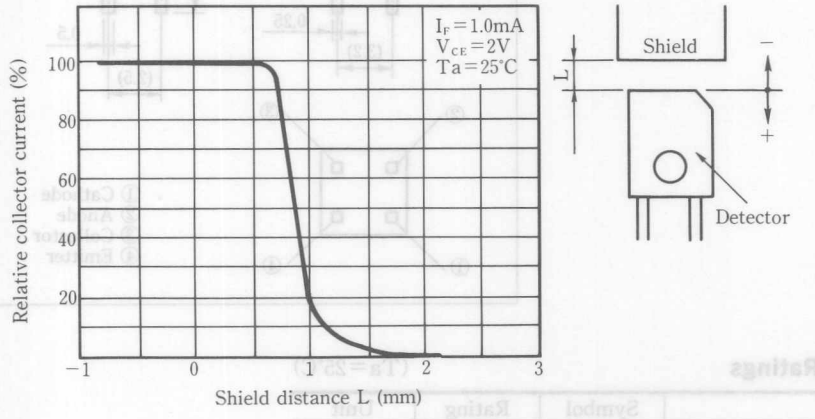


Fig. 11 Relative Collector Current vs. Shield Distance (2)



7

GP1L22 Subminiature Photointerrupter

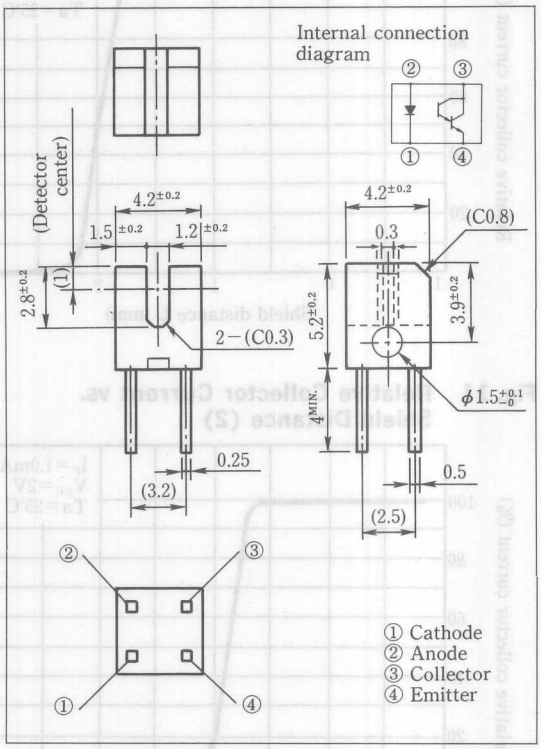
■ Features

1. Ultra-compact (Capacity : 0.06cc)
2. PWB mounting type package
3. High sensing accuracy (Slit width : 0.3mm)

■ Applications

1. Still carera
2. Miniprinter
3. Microfloppy disk drives

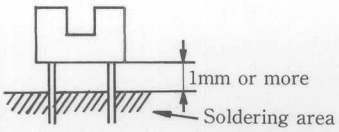
■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 For 5 seconds



■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=3V	0	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	20	—	700	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=0.2mA	—	—	1.0	V
	Response time (Rise)	t_r	I_C=10mA, V_{CE}=2V, R_L=100Ω	—	80	400	μs
	Response time (Fall)	t_f		—	70	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

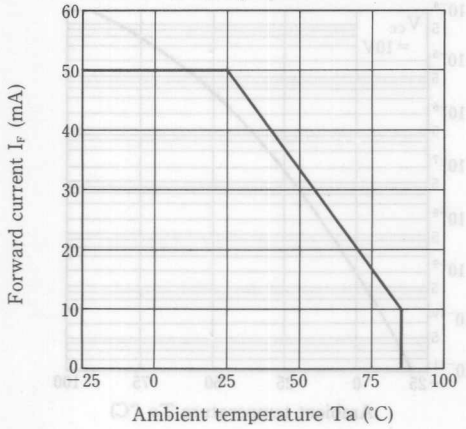


Fig. 2 Power Dissipation vs. Ambient Temperature

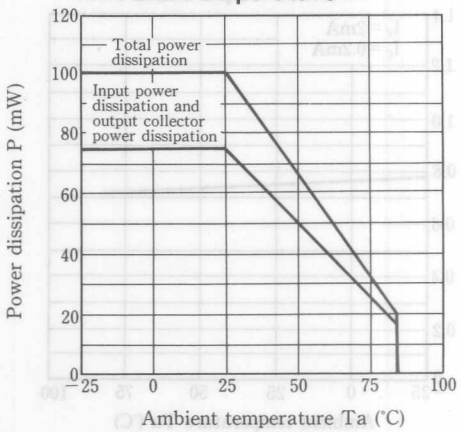


Fig. 3 Forward Current vs. Forward Voltage

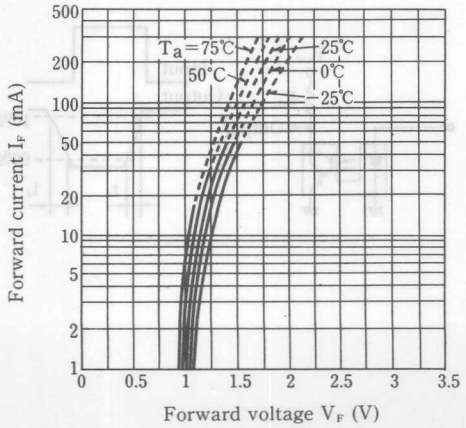
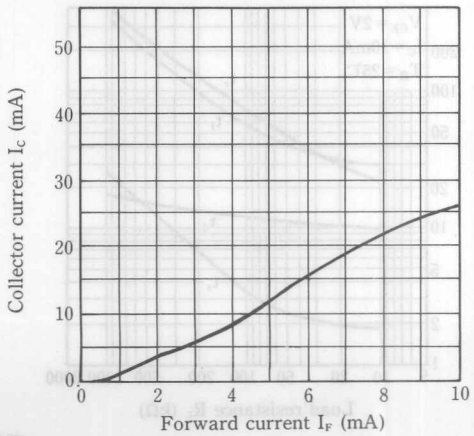


Fig. 4 Collector Current vs. Forward Current



7

Fig. 5 Collector Current vs. Collector-emitter Voltage

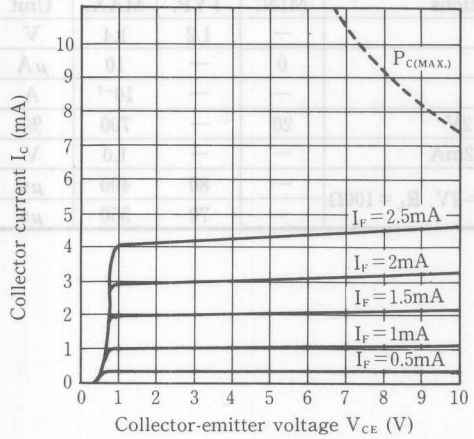


Fig. 6 Collector Current vs. Ambient Temperature

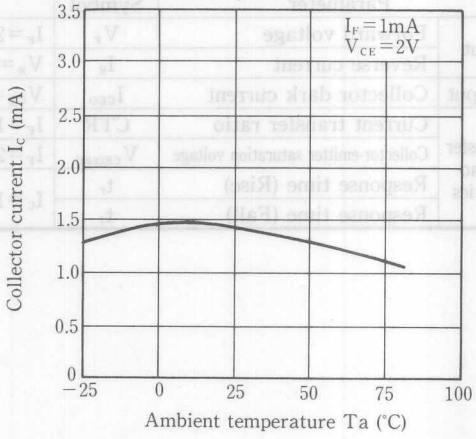


Fig. 7 Collector-emitter Saturation Voltage vs. Ambient Temperature

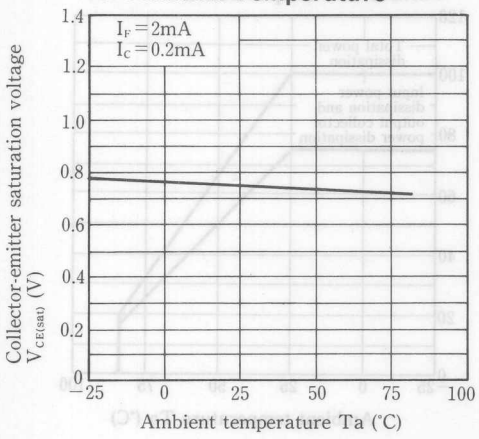


Fig. 8 Collector Dark Current vs. Ambient Temperature

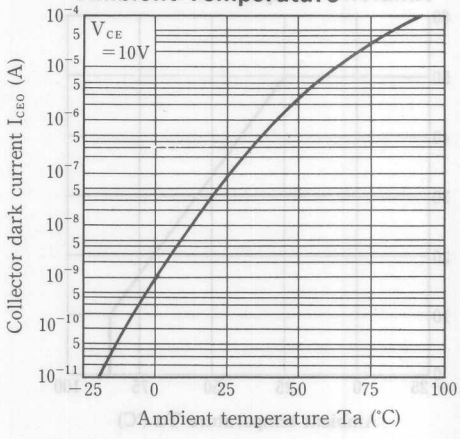
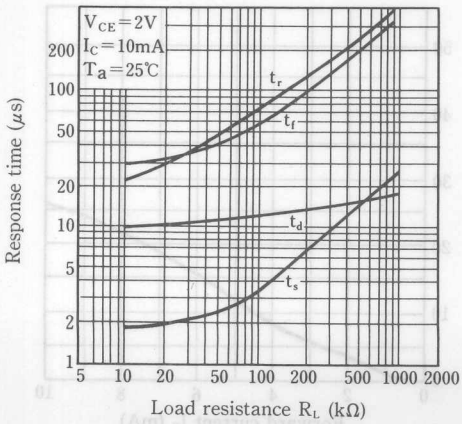


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

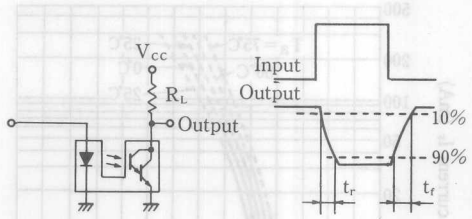
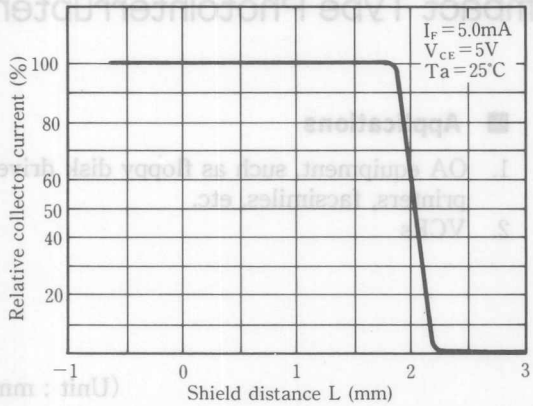


Fig. 10 Relative Collector Current vs. Shield Distance (1)



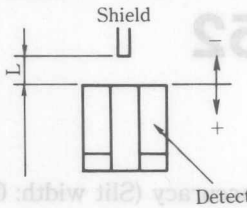
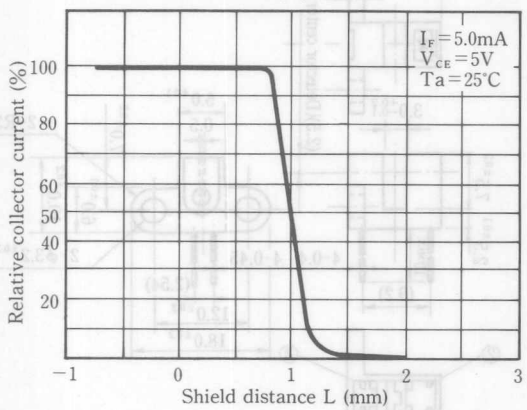
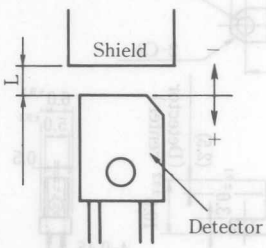


Fig. 11 Relative Collector Current vs. Shield Distance (2)





7

GP1L50/GP1L51/GP1L52 Compact Type Photointerrupter

■ Features

1. Compact type
2. High sensing accuracy (Slit width: 0.5mm)
3. High current transfer ratio
   (CTR: MIN. 50% at I_F = 1mA)
4. Both-sides mounting type: GP1L50
   Either-side mounting type: GP1L51
   PWB direct mounting type: GP1L52

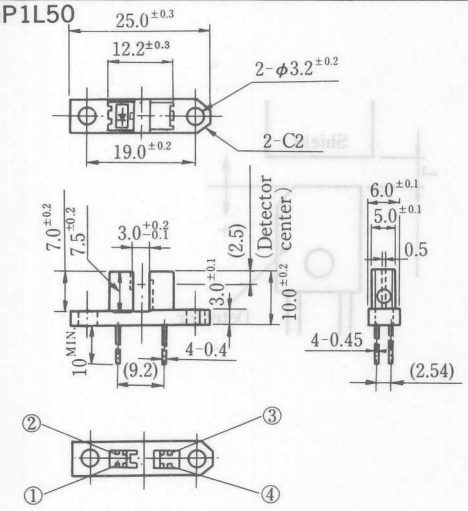
■ Applications

1. OA equipment, such as floppy disk drives, printers, facsimiles, etc.
2. VCRs

■ Outline Dimensions

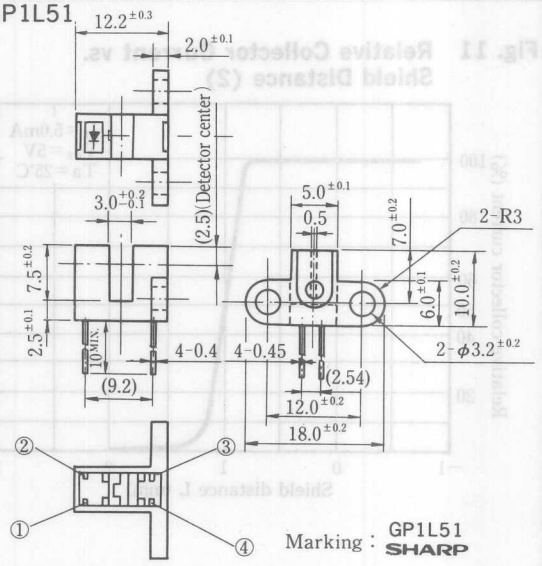
(Unit : mm)

GP1L50



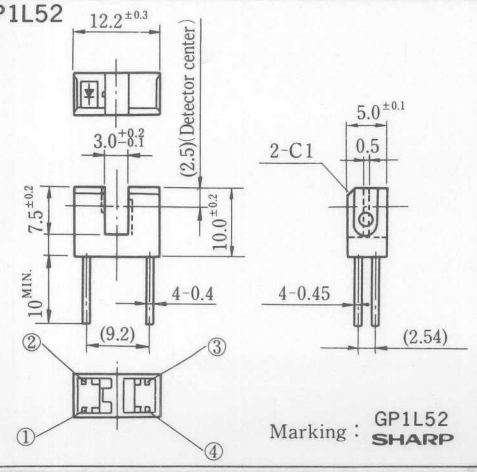
Marking : GP1L50 SHARP

GP1L51



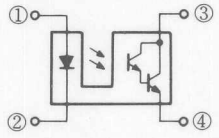
Marking : GP1L51 SHARP

GP1L52



Marking : GP1L52 SHARP

Internal connection diagram
(Common to 3 models)



① Anode
② Cathode
③ Collector
④ Emitter

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.25	1.4	V
	Peak forward voltage	F_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	50	—	2,000	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=0.5mA	—	—	1.0	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	80	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	70	350	μs

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Fig. 1 Forward Current vs. Ambient Temperature

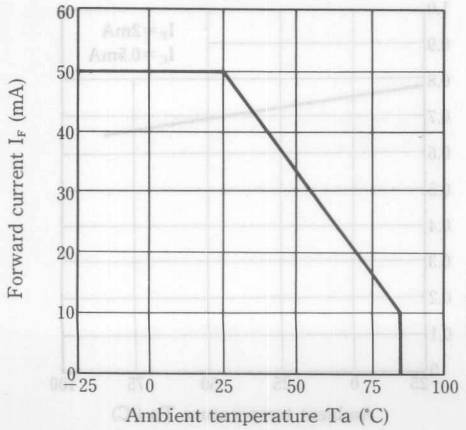


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

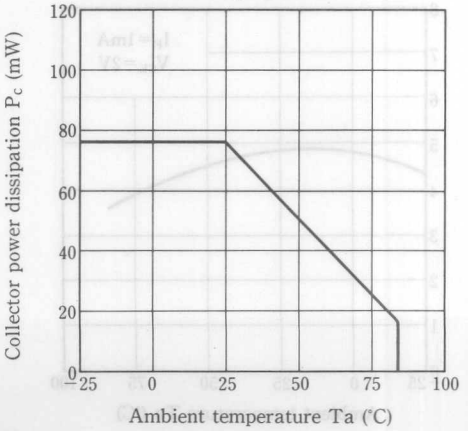


Fig. 3 Peak Forward Current vs. Duty Ratio

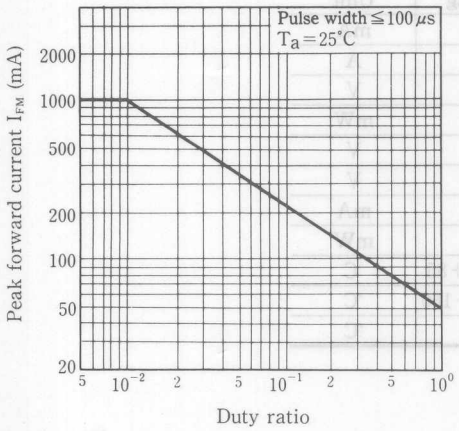


Fig. 4 Forward Current vs. Forward Voltage

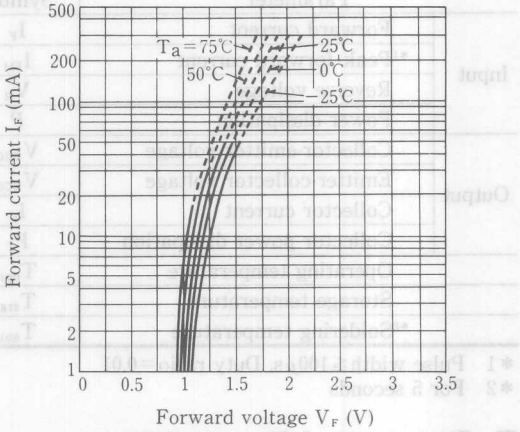


Fig. 5 Collector Current vs. Forward Current

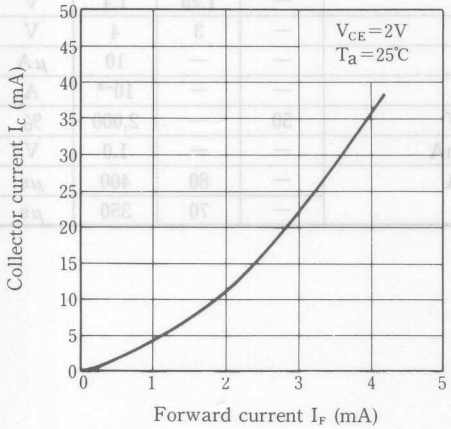


Fig. 6 Collector Current vs. Collector-emitter Voltage

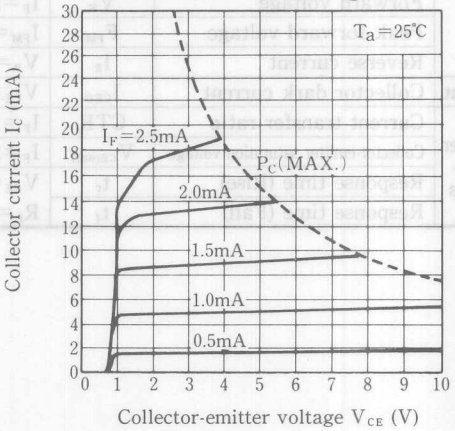


Fig. 7 Collector Current vs. Ambient Temperature

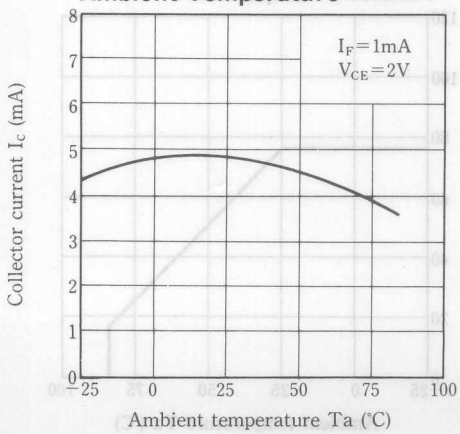


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

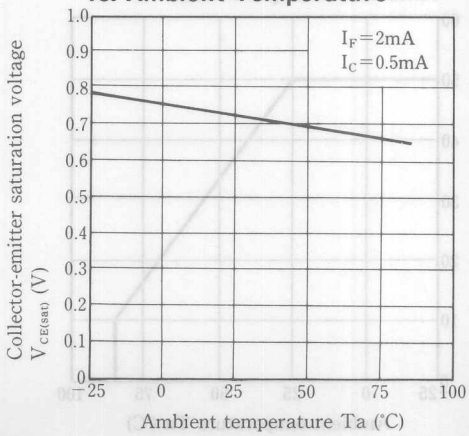
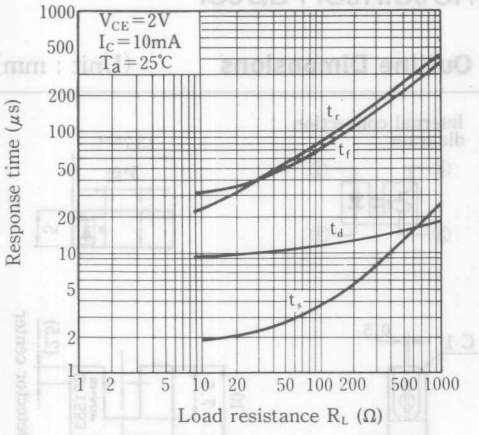


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

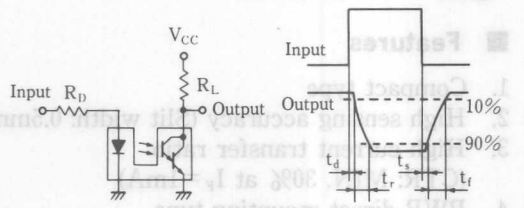


Fig. 10 Frequency Response

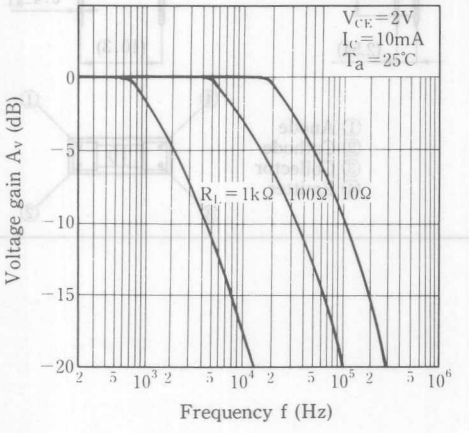


Fig. 11 Collector Dark Current vs. Ambient Temperature

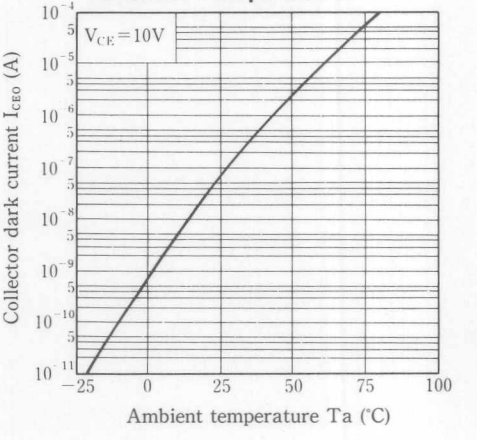


Fig. 12 Relative Collector Current vs. Shield Distance (1)

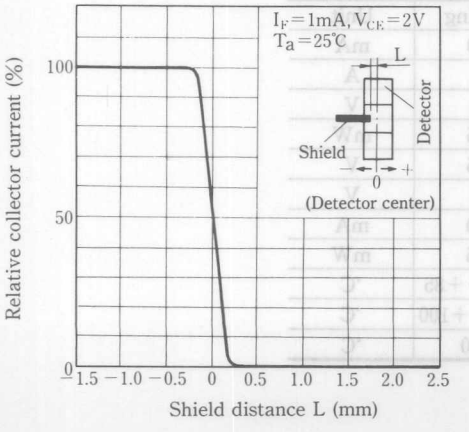
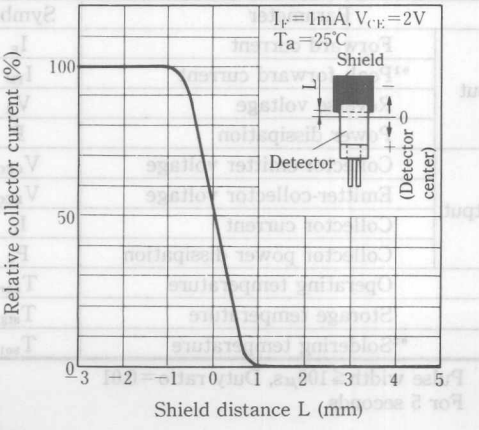


Fig. 13 Relative Collector Current vs. Shield Distance (2)



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GP1L53 Compact Type Photointerrupter

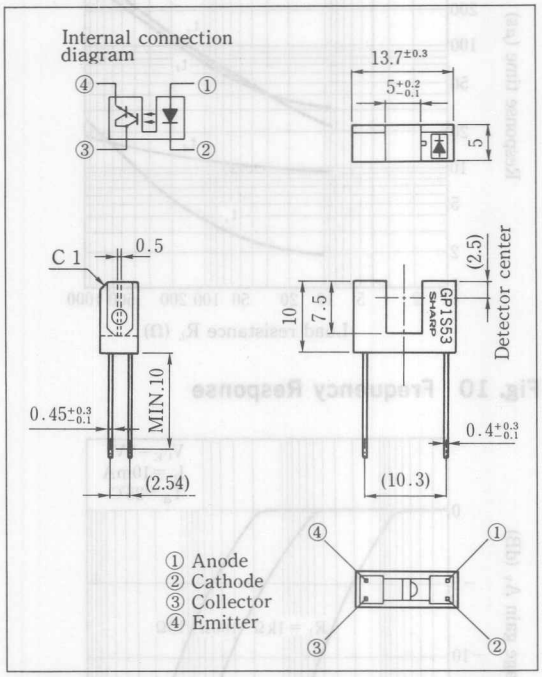
■ Features

1. Compact type
2. High sensing accuracy (Slit width: 0.5mm)
3. High current transfer ratio (CTR: MIN. 30% at I_F=1mA)
4. PWB direct mounting type

■ Applications

1. OA equipment such as FDDs, printers, facsimiles, etc.
2. VCRs
3. Optoelectronic switches

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.25	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse Current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-6}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=1mA, V_{CE}=2V	30	—	2,000	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=0.3mA	—	—	1.0	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	130	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	100	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

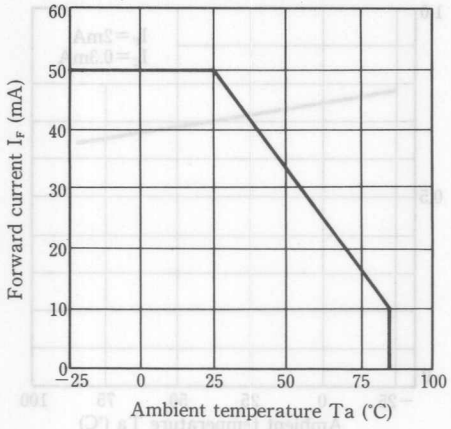


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

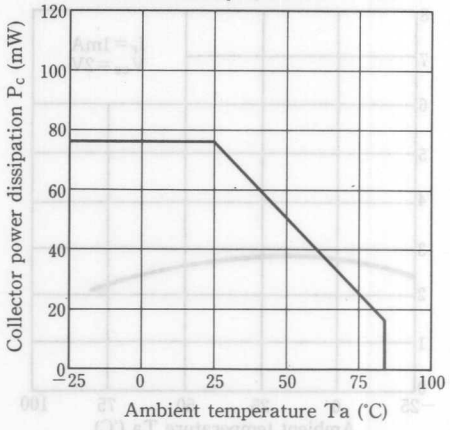


Fig. 3 Peak Forward Current vs. Duty Ratio

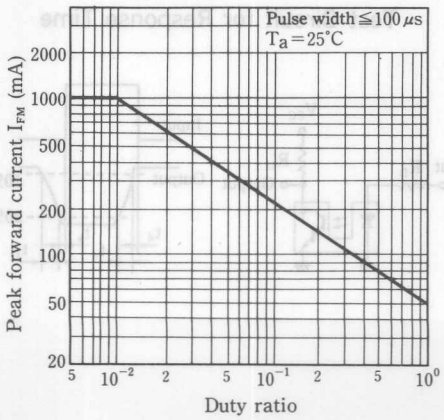
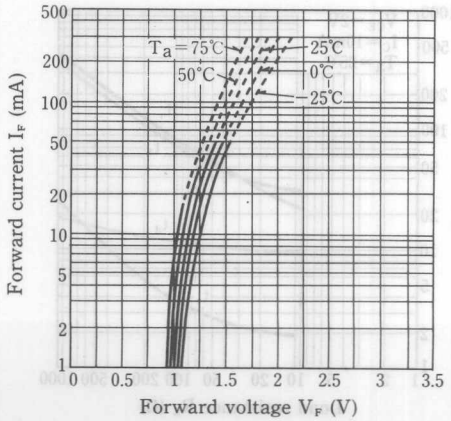


Fig. 4 Forward Current vs. Forward Voltage



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Fig. 5 Collector Current vs. Forward Current

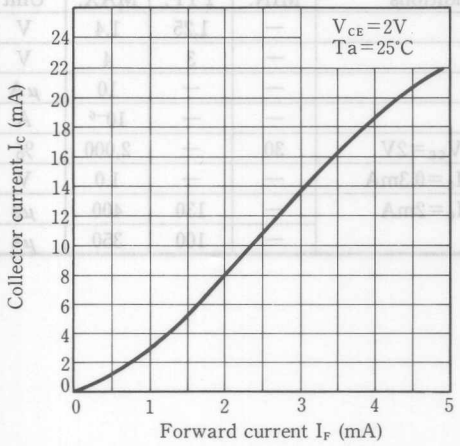


Fig. 6 Collector Current vs. Collector-emitter Voltage

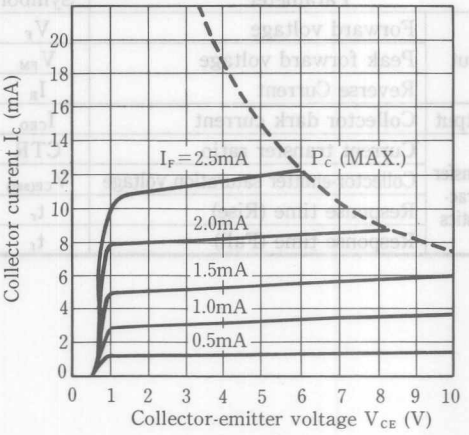


Fig. 7 Collector Current vs. Ambient Temperature

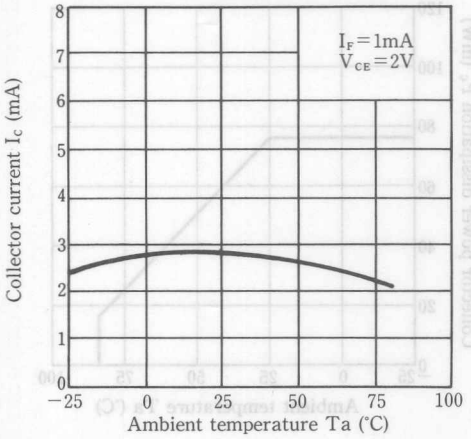


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

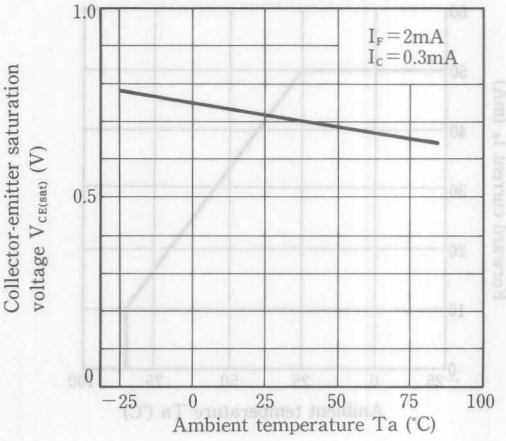
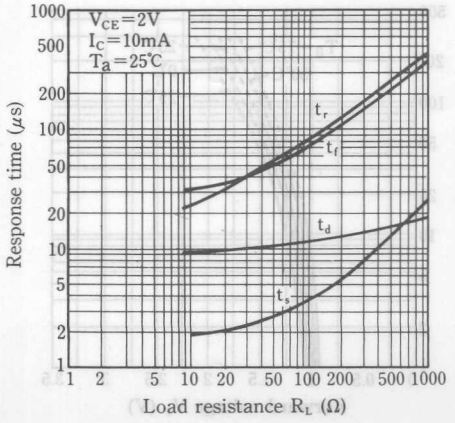


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

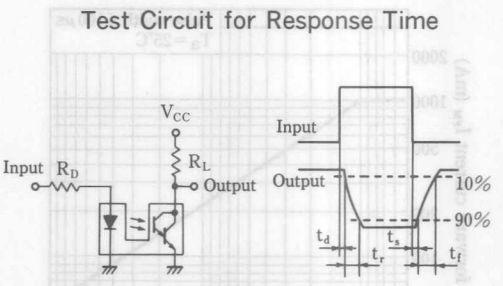


Fig. 10 Frequency Response

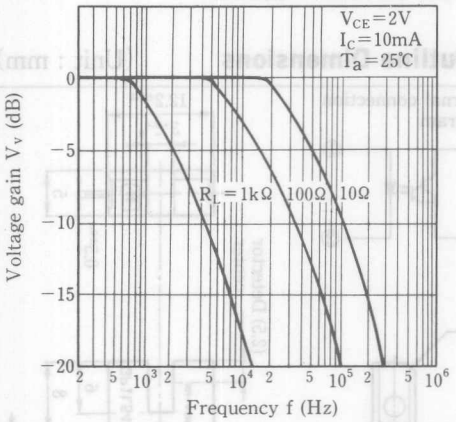


Fig. 11 Collector Dark Current vs. Ambient Temperature

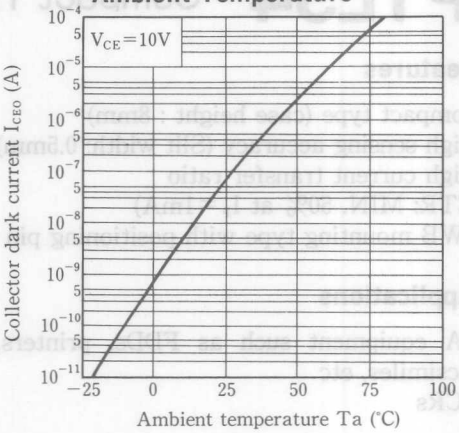


Fig. 12 Relative Collector Current vs. Shield Distance (1)

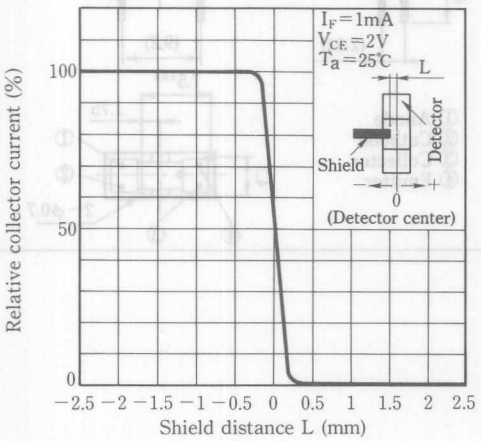
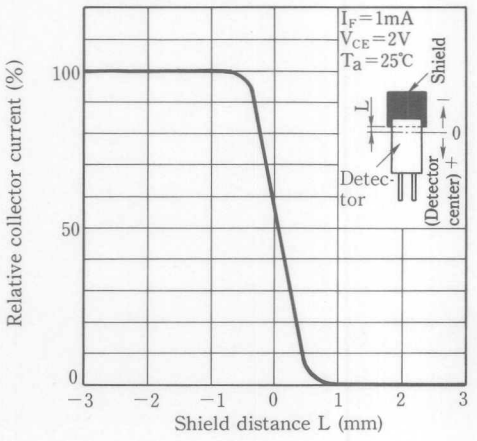


Fig. 13 Relative Collector Current vs. Shield Distance (2)



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GP1L54 Compact Type Photointerrupter

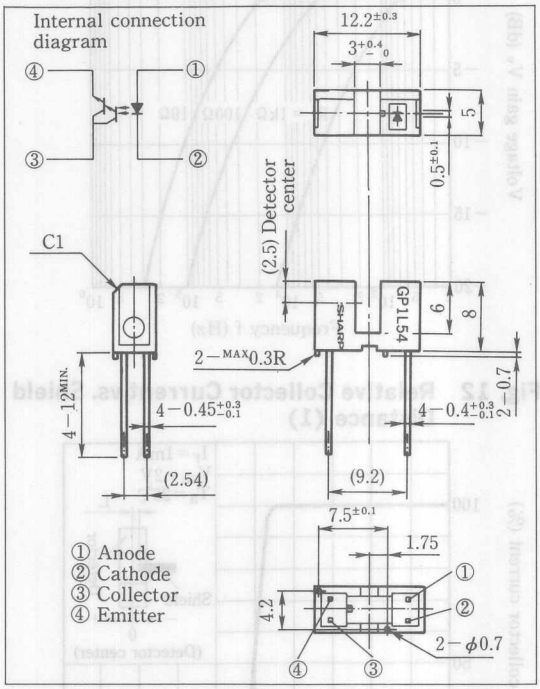
■ Features

1. Compact type (case height : 8mm)
2. High sensing accuracy (Slit width: 0.5mm)
3. High current transfer ratio
   (CTR: MIN. 50% at I_F=1mA)
4. PWB mounting type with positioning pin

■ Applications

1. OA equipment such as FDDs, printers, facsimiles, etc
2. VCRs

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.25	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse Current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	10^{-6}	A
Transfer characteristics	Current tranfer ratio	CTR	I_F=1mA, V_{CE}=2V	50	—	2,000	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=2mA, I_C=0.5mA	—	—	1.0	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	80	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	70	350	μs

Fig. 1 Forward Current vs. Ambient Temperature

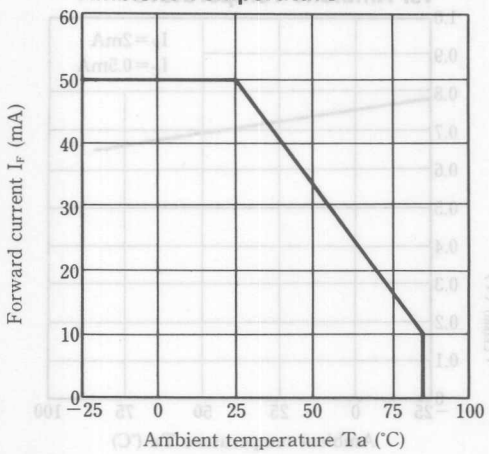


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

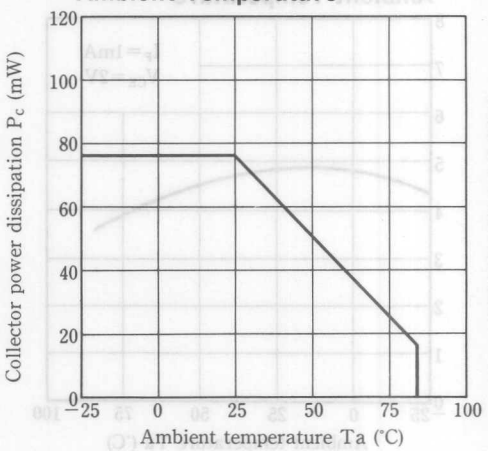


Fig. 3 Peak Forward Current vs. Duty Ratio

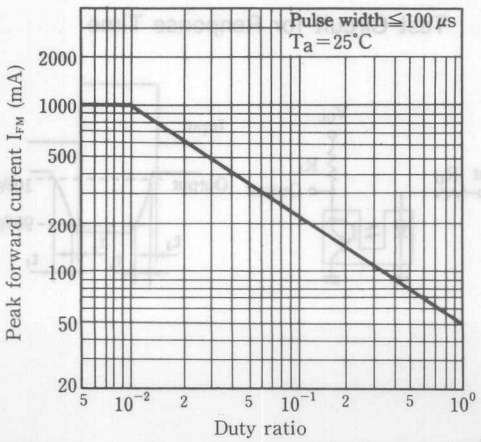
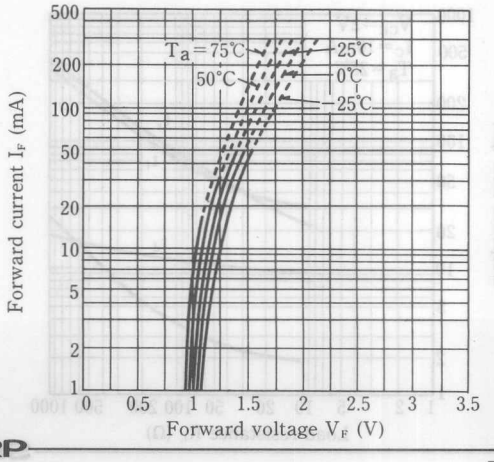


Fig. 4 Forward Current vs. Forward Voltage



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Fig. 5 Collector Current vs. Forward Current

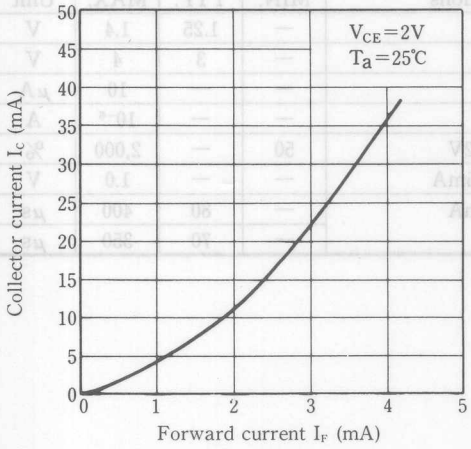


Fig. 6 Collector Current vs. Collector-emitter Voltage

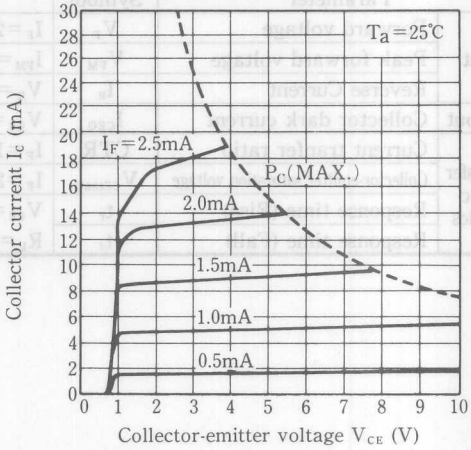


Fig. 7 Collectmr Current vs. Ambient Temperature

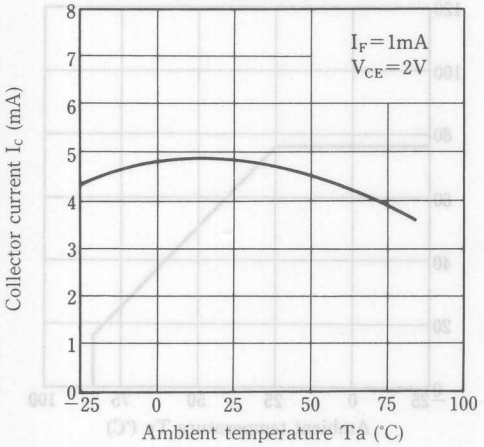


Fig. 8 Collector-emitter Saturation Voltage vs. Ambient Temperature

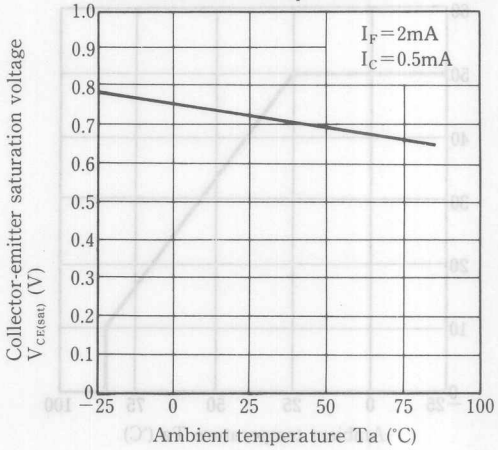
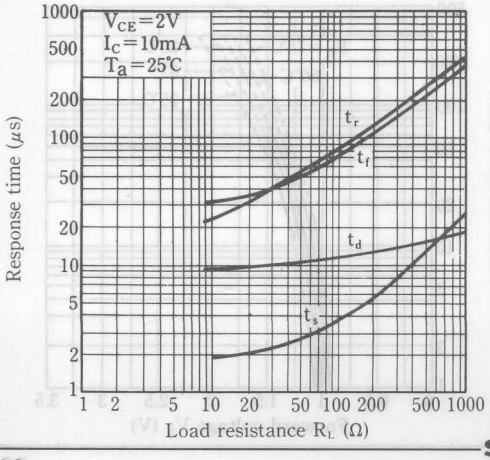


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Renponse Time

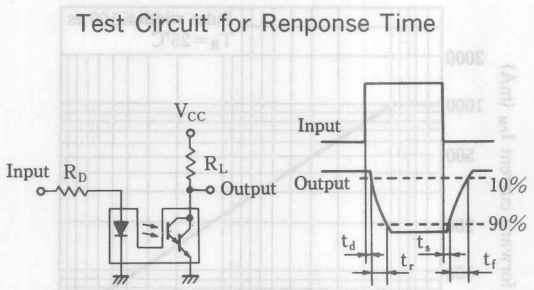


Fig. 10 Frequency Response

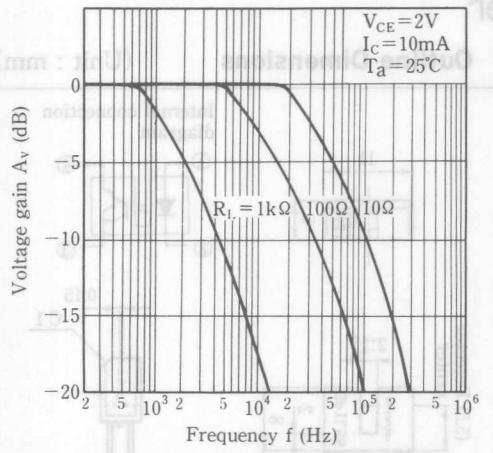


Fig. 11 Collector Dark Current vs. Ambient Temperatue

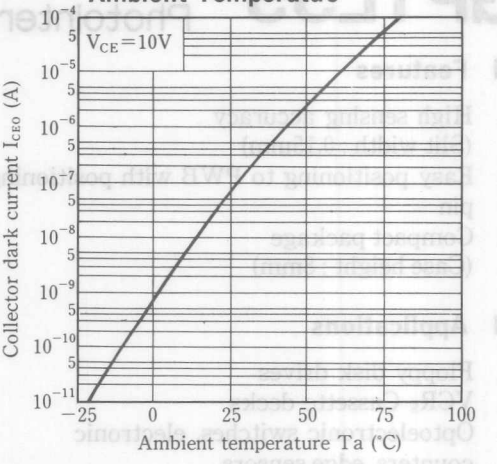


Fig. 12 Relative Collector Current vs. Shield Distance (1)

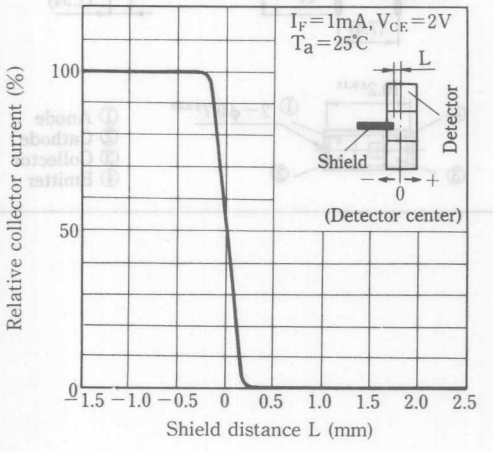
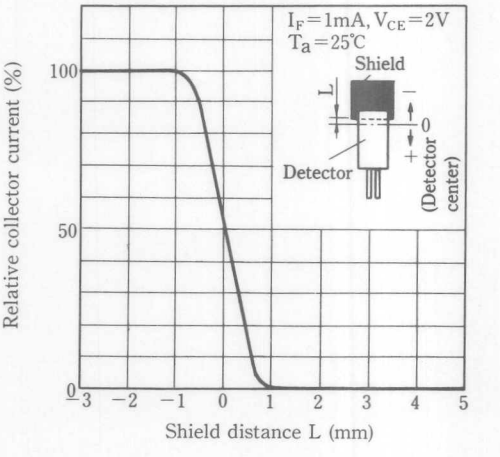


Fig. 13 Relative Collector Current vs. Shield Distance (2)



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GP1L55 Narrow Gap Type High Sensitivity Photointerrupter

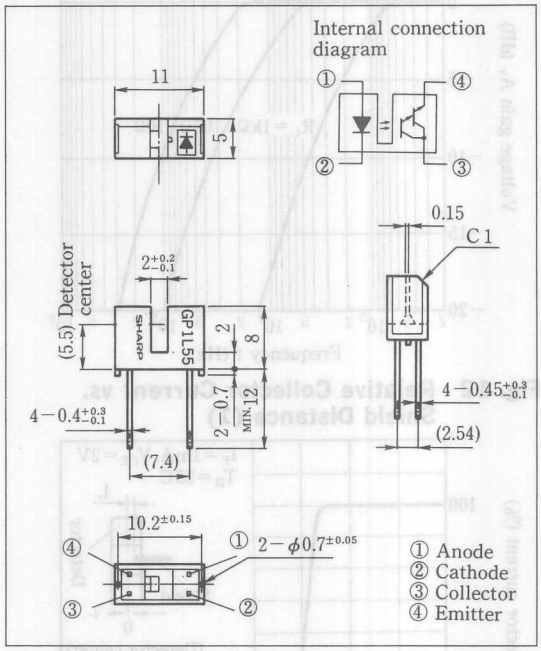
■ Features

1. High sensing accuracy
   (Slit width : 0.15mm)
2. Easy positioning to PWB with positioning pin
3. Compact package
   (Case height : 8mm)

■ Applications

1. Floppy disk drives
2. VCRs Cassette decks
3. Optoelectronic switches, electronic counters, edge sensors.

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-cmitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2 Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	10^{-9}	10^{-7}	A
Transfer characteristics	Current transfer ratio	CTR	I_F=2mA, V_{CE}=2V	30	—	—	%
	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_F=4mA, I_C=0.6mA	—	—	1	V
	Response time (Rise)	t_r	V_{CE}=2V, I_C=10mA	—	80	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	70	350	μs

(Precautions for Use)

It should be taken into consideration in your application that vibrations may cause the collector current to vary in the range of up to 20% due to its structural design.

Fig.1 Forward Current vs. Ambient Temperature

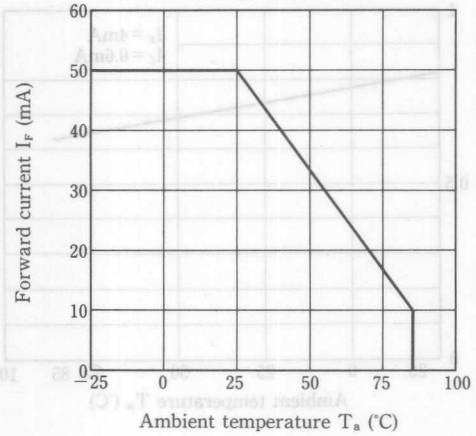


Fig.2 Collector Power Dissipation vs. Ambient Temperature

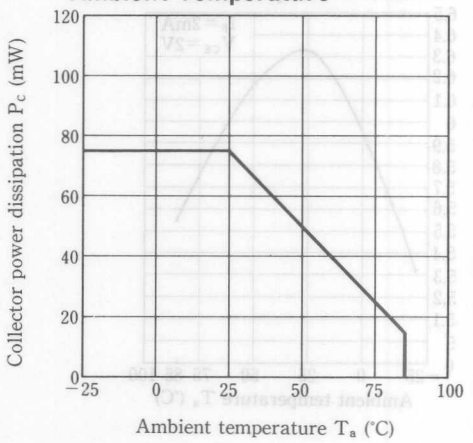


Fig.3 Peak Forward Current vs. Duty Ratio

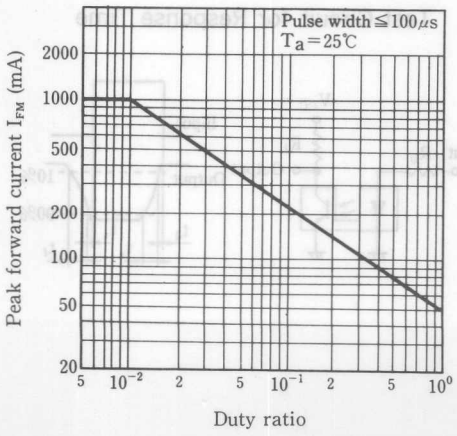
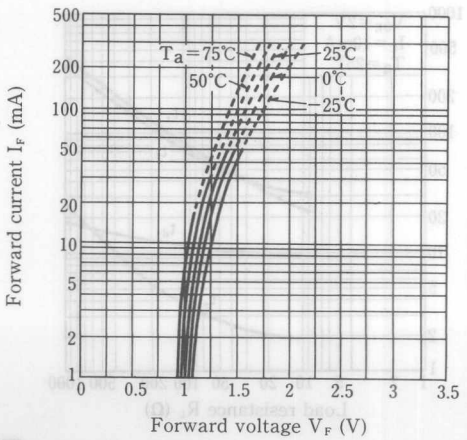


Fig.4 Forward Current vs. Forward Voltage



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Fig.5 Collector Current vs. Forward Current

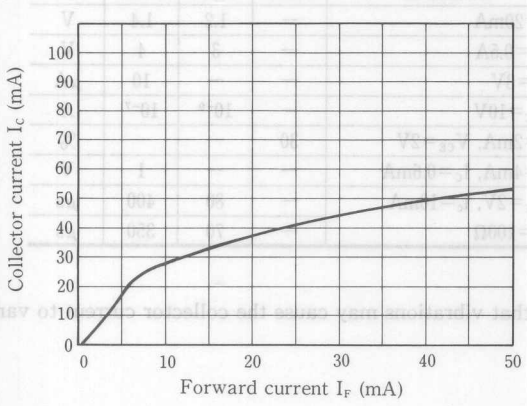


Fig.6 Collector Current vs. Collector-emitter voltage

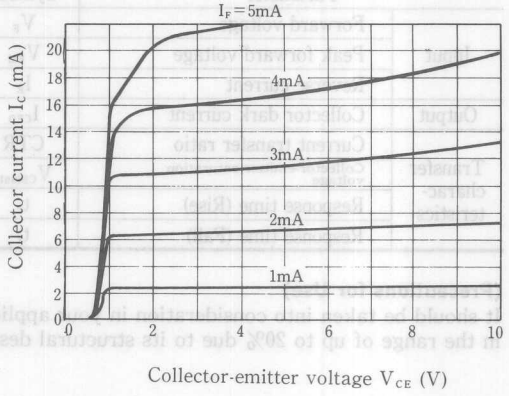


Fig.7 Collector Current vs. Ambient Temperature

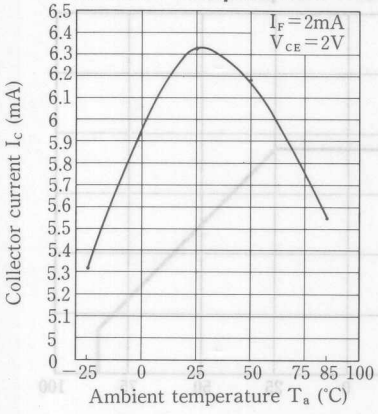


Fig.8 Collector-emitter Saturation Voltage vs. Ambient Temperature

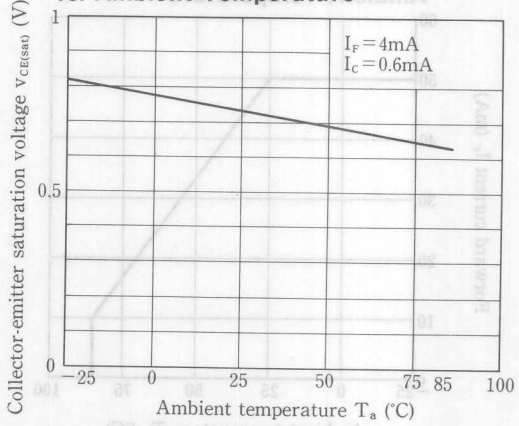
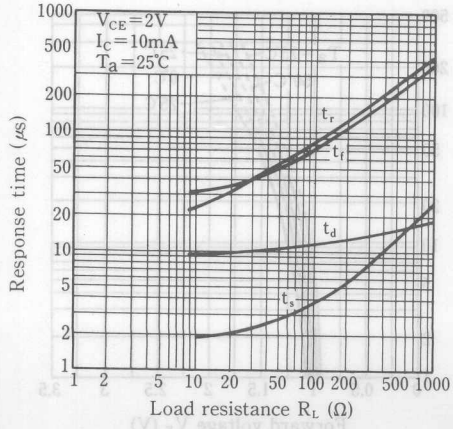


Fig.9 Response Time vs. Load Resistance



Test Circuit for Response Time

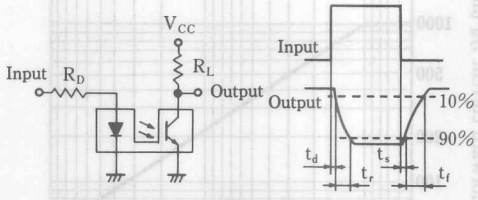


Fig.10 Relative Collector Current vs. Shield Distance (1)

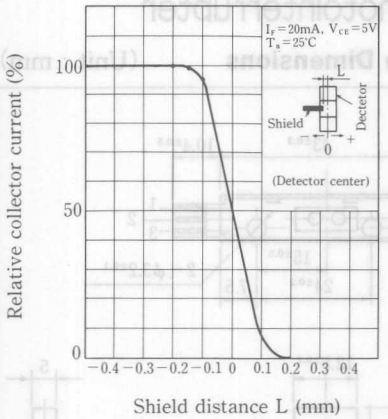
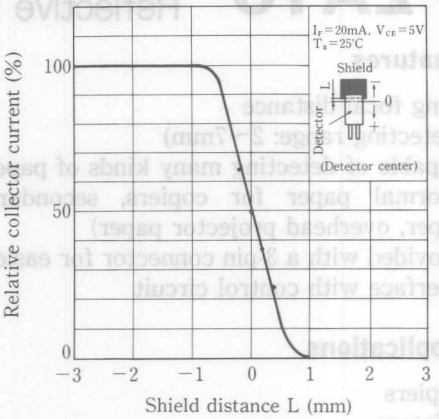


Fig.11 Relative Collector Current vs. Shield Distance (2)



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GP2A10 Long Focal Distance, Open Collector Output, Reflective Type OPIC Photointerrupter

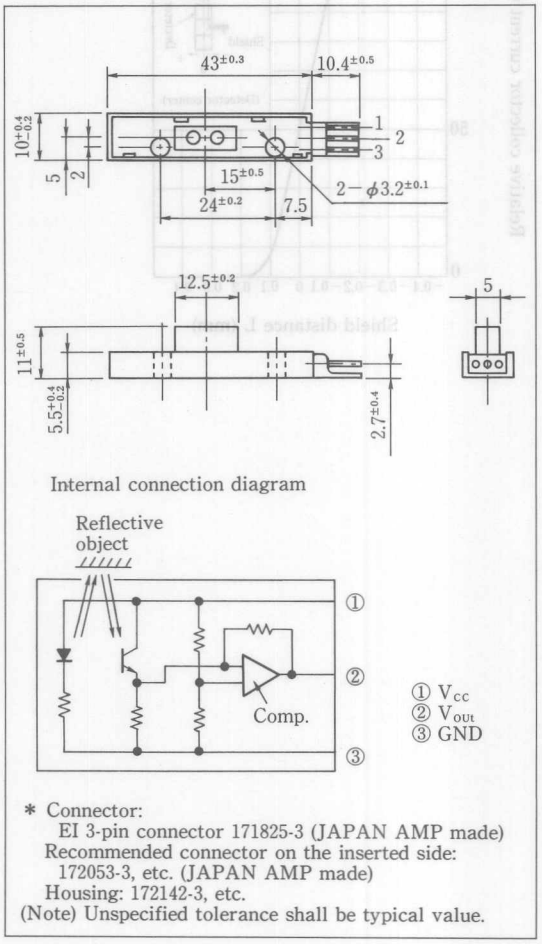
■ Features

1. Long focal distance
   (Detecting range: 2～7mm)
2. Capable of detecting many kinds of paper
   (Normal paper for copiers, secondary paper, overhead projector paper)
3. Provided with a 3-pin connector for easier interface with control circuit

■ Applications

1. Copiers
2. Printers
3. Facsimiles

■ Outline Dimensions (Unit : mm)



* Connector:
EI 3-pin connector 171825-3 (JAPAN AMP made)
Recommended connector on the inserted side:
172053-3, etc. (JAPAN AMP made)
Housing: 172142-3, etc.
(Note) Unspecified tolerance shall be typical value.

※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	7	V
*1Output voltage	V_O	30	V
*2Low level output current	I_{OL}	6	mA
*3Operating temperature	T_{opr}	0～+65	°C
*3Storage temperature	T_{stg}	−40～+80	°C

*1 Detecting time
*2 Non-detecting time
*3 The connector should be plugged in/out at normal temperature.

■ Electro-optical Characteristics (Ta=25°C)

Parameter	Symbol	Conditions	Rating MIN.	Rating TYP.	Rating MAX.	Unit
Operating supply voltage	V_{CC}	Ta=0~65°C	4.5	5.0	5.5	V
Dissipation current	I_{CC}	V_{CC}=5V, R_L=∞ at detecting time	—	27	50	mA
Low level output voltage	V_{OL}	V_{CC}=5V at non-detecting time I_{OL}=3mA	—	0.2	0.4	V
High level output voltage	V_{OH}	V_{CC}=5V at detecting time R_L=10kΩ	4.7	—	—	V
Detecting characteristics	V_{OUT}	*4		V_{OL}		—
		*5		V_{OH}		—
*6Response time	t_r	R_L=10kΩ	—	—	2	ms
	t_f		—	—	2	ms

*4 Non-detecting condition: d=11mm or more (without external disturbing light) with suede (black) as the reflective object in Fig. 1

*5 Detecting condition: d=2~7mm (without external disturbing light) with artwork tape (black) as the reflective object in Fig. 2

*6 Definition of response time: shown in Fig. 2

Fig.1

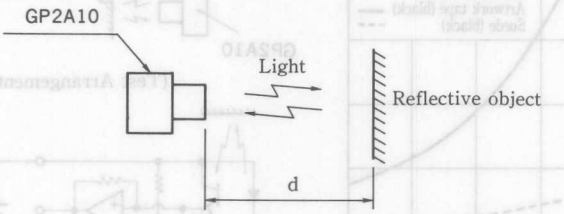
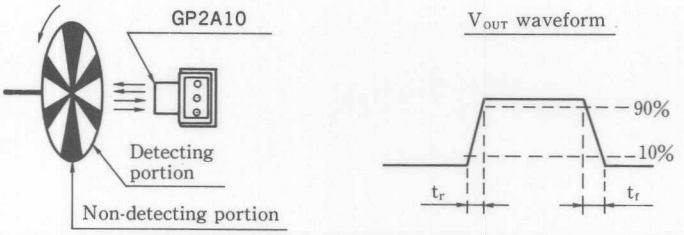


Fig. 2



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Fig. 3 Low Level Output Voltage vs. Ambient Temperature

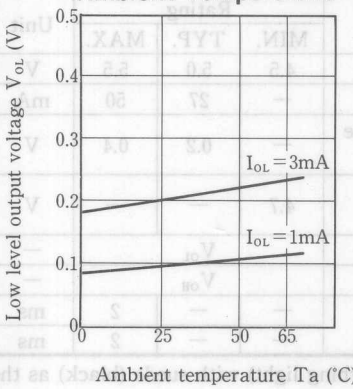


Fig. 4 Dissipation Current vs. Supply Voltage

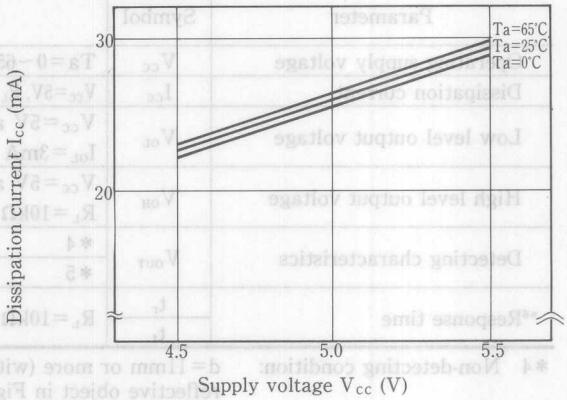
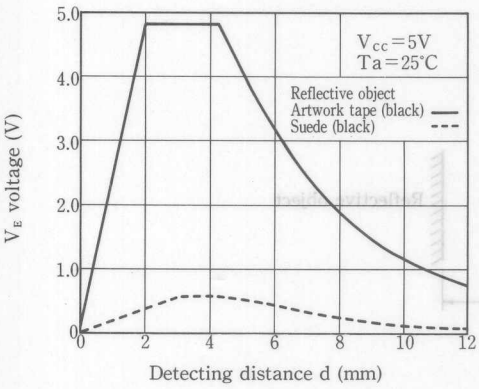
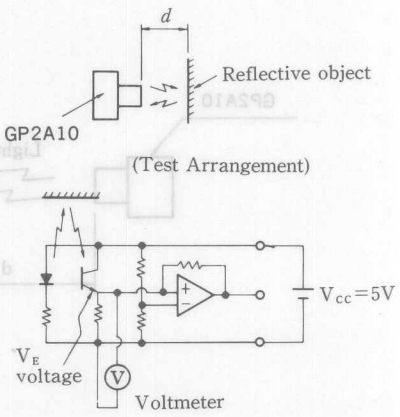


Fig. 5 Detecting Distance Characteristics





(Test Circuit Diagram)

GP2A11 Light Modulation, Reflective Type OPIC Photointerrupter

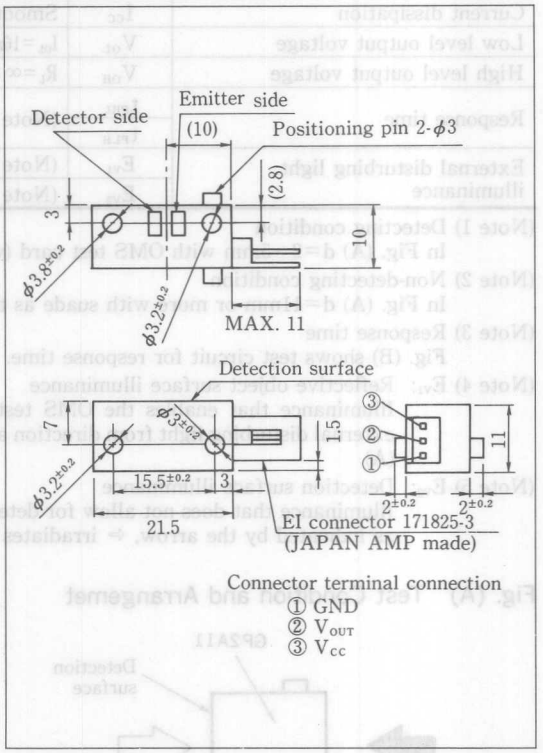
■ Features

1. Light modulation type free from external disturbing light
   (External disturbing light illuminance: 2,000 ℓx)
2. OPIC provides compactness and high performance.
3. With connector provided for easier interface with peripheral control circuit

■ Applications

1. Copiers
2. Printers
3. Automatic vending machines

■ Outline Dimensions (Unit : mm)



※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	−0.5～+16	V
Output voltage	V_{OUT}	16	V
Output current	I_{OL}	50	mA
Operating temperature	T_{opr}	−10～+65	°C
Storage temperature	T_{stg}	−40～+80	°C

The connector should be plugged in / out at normal temperature.

■ Electro-optical Characteristics

(Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{CC}		4.5	5.0	5.5	V
Current dissipation	I_{CCP}	Peak pulse value, $R_L=\infty$	—	—	100	mA
Current dissipation	I_{CC}	Smoothing value, $R_L=\infty$	—	—	20	mA
Low level output voltage	V_{OL}	I_{OL}=16mA at detecting time (Note 1)	—	0.2	0.4	V
High level output voltage	V_{OH}	$R_L=\infty$ at non-detecting time (Note 2)	4.7	—	—	V
Response time	t_{PHL}	(Note 3)	—	—	1	msec.
	t_{PLH}		—	—	1	msec.
External disturbing light illuminance	E_{V1}	(Note 4)	2000	—	—	ℓx
	E_{V2}	(Note 5)	2000	—	—	ℓx

(Note 1) Detecting condition
In Fig. (A) d=2~5mm with OMS test card (white) as the reflective object (Specified by Sharp)

(Note 2) Non-detecting condition
In Fig. (A) d=11mm or more with suade as the reflective object (Specified by Sharp)

(Note 3) Response time
Fig. (B) shows test circuit for response time.

(Note 4) E_{V1}: Reflective object surface illuminance
Illuminance that enables the OMS test card (white) to be detected with d=2~5mm when the external disturbing light from direction as indicated by the arrow, ➡ irradiates light source A in Fig. (A)

(Note 5) E_{V2}: Detection surface illuminance
Illuminance that does not allow for detection when the external disturbing light from the direction as indicated by the arrow, ⇦ irradiates light source A in Fig. (A)

Fig. (A) Test Condition and Arrangemet

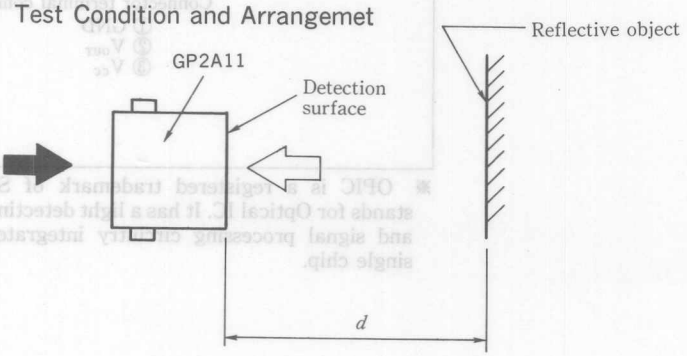
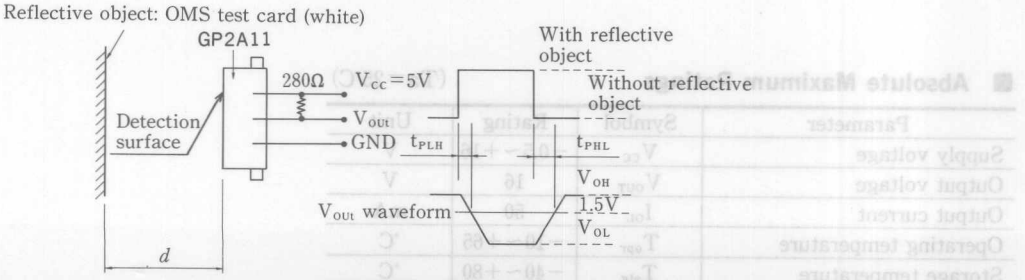


Fig. (B) Test Circuit for Response Time



■ Circuit Block Diagram

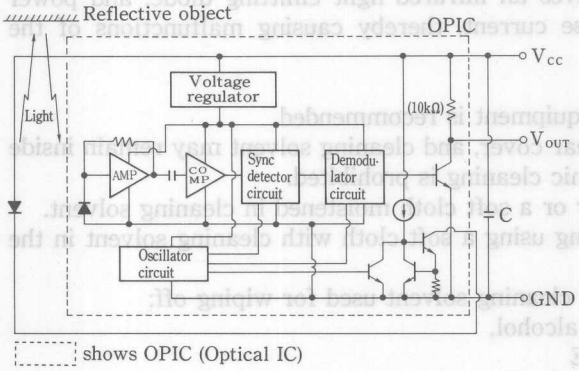


Fig. 1 Dissipation Current (Peak Pulse Value) vs. Ambient Temperature

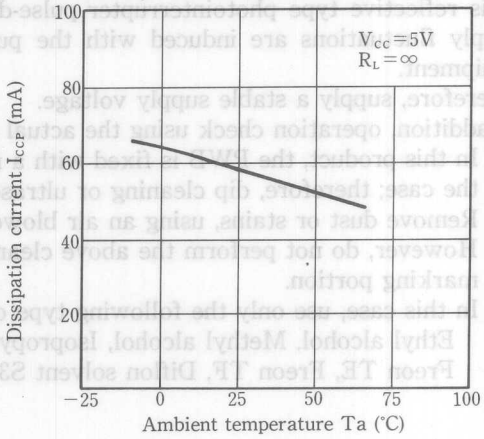


Fig. 2 Dissipation Current (Smoothing Value) vs. Ambient Temperature

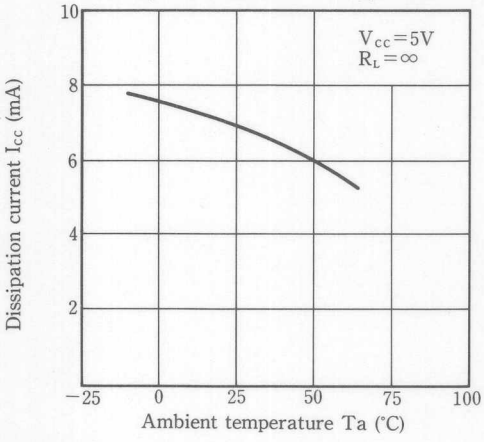


Fig. 3 Low Level Output Current vs. Ambient Temperature

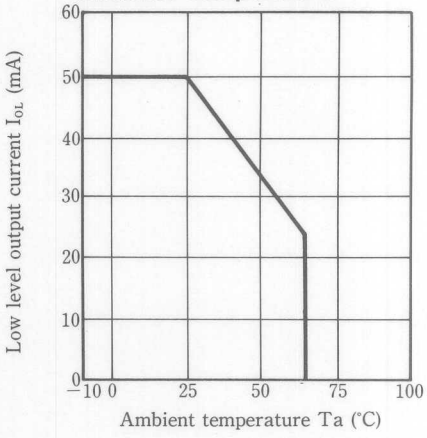


Fig. 4 Low Level Output Voltage vs. Ambient Temperature

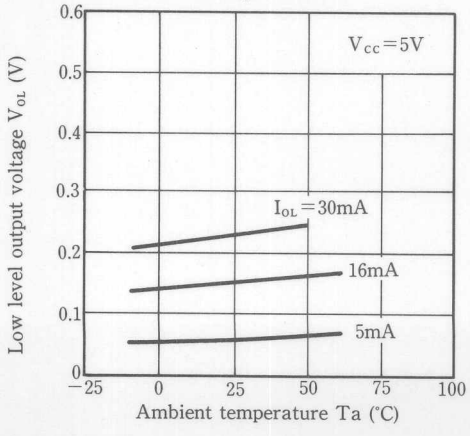
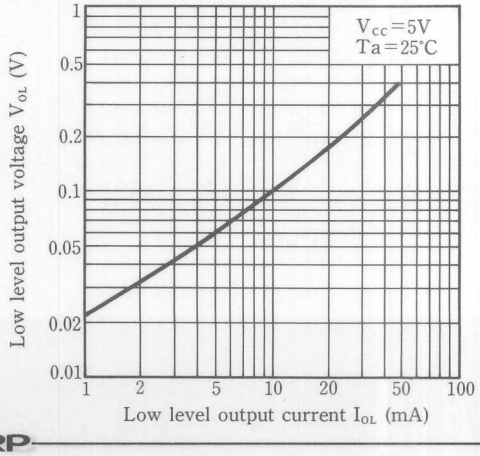


Fig. 5 Low Level Output Voltage vs. Low Level Output Current



7

■ Precautions for Use

This reflective type photointerrupter pulse-drives an infrared light emitting diode, and power supply fluctuations are induced with the pulse current, thereby causing malfunctions of the equipment.

Therefore, supply a stable supply voltage.

In addition, operation check using the actual equipment is recommended.

1) In this product, the PWB is fixed with a rear cover, and cleaning solvent may remain inside the case; therefore, dip cleaning or ultrasonic cleaning is prohibited.
2) Remove dust or stains, using an air blower or a soft cloth moistened in cleaning solvent. However, do not perform the above cleaning using a soft cloth with cleaning solvent in the marking portion.
   In this case, use only the following type of cleaning solvent used for wiping off:
   Ethyl alcohol, Methyl alcohol, Isopropyl alcohol,
   Freon TE, Freon TF, Diflon solvent S3-E

GP2A12F Long Focal Distance, Open Collector Output, Reflective Type OPIC Photointerrupter

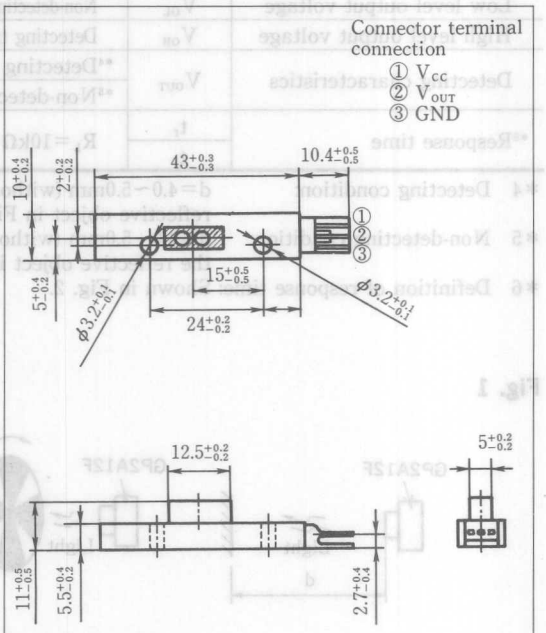
■ Features

1. Dust-proof type
2. Visible light cut-off type
3. Long focal distance type (Detecting range: 4~5mm)
4. Capable of paper detection on platen (Thermal paper for printers, plain paper for copiers, etc.)
5. Provided with a 3-pin connector for easier interface with control circuit

■ Applications

1. Paper detection for printers, copiers, facsimiles, etc.

■ Outline Dimensions (Unit : mm)



▨ Portion: Polyester film

Connector Model No.: EI connector 171825-3 (JAPAN AMP made)

Recommended connectors on the inserted side: 172053-3, etc. (JAPAN AMP made)

※ OPIC is a registered trademark of Sharp and stands for Optical IC. It has a light detecting element and signal processing circuitry integrated onto a single chip.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	7	V
*1Output voltage	V_O	30	V
*2Low level output current	I_{OL}	6	mA
*3Operating temperature	T_{opr}	−10~+70	°C
*3Storage temperature	T_{stg}	−40~+80	°C

*1 Detecting time
*2 Non-detecting time
*3 The connector should be plugged in/out at normal temperature.

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{CC}	Ta=−10~+70°	4.5	5.0	5.5	V
Dissipation current	I_{CC}	Detecting time V_{CC}=5V, R_L=∞	—	27	50	mA
Low level output voltage	V_{OL}	Non-detecting time V_{CC}=5V I_{OL}=3mA	—	0.2	0.4	V
High level output voltage	V_{OH}	Detecting time V_{CC}=5V R_L=10kΩ	4.7	—	—	V
Detecting characteristics	V_{OUT}	*4Detecting condition	V_{OH}			V
		*5Non-detecting condition	V_{OL}			V
*6Response time	t_r	R_L=10kΩ	—	—	2.0	ms
	t_f		—	—	2.0	ms

*4 Detecting condition: d=4.0~5.0mm (without external disturbing light) with PPC paper (white) as the reflective object in Fig. 1.

*5 Non-detecting condition: d=4.0~5.0mm (without external disturbing light) with artwork tape (black) as the reflective object in Fig. 1.

*6 Definition of response time: Shown in Fig. 2.

Fig. 1

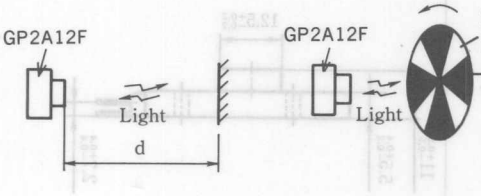
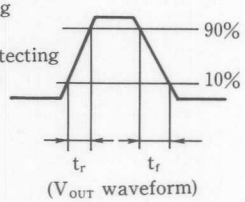


Fig. 2



(Circuit Diagram)

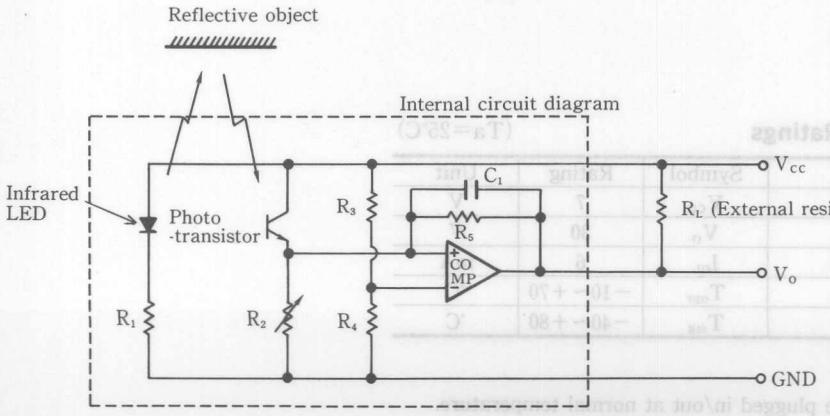


Fig. 3 Low Level Output Voltage vs. Ambient Temperature

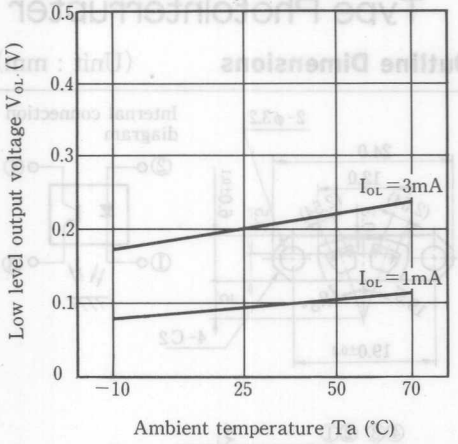
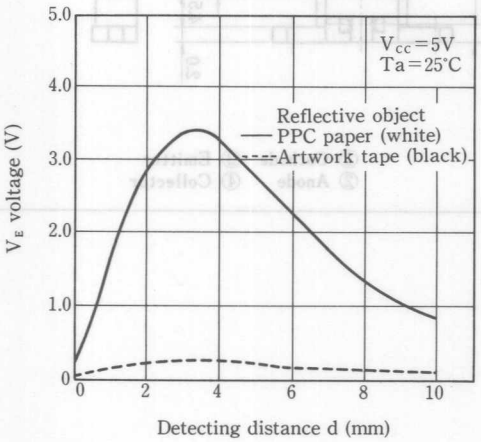
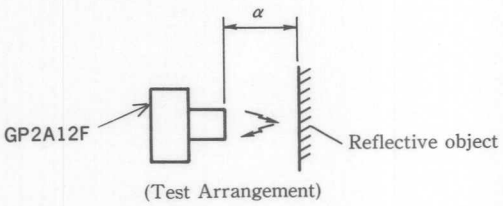


Fig. 4 Current Dissipation vs. Supply Voltage

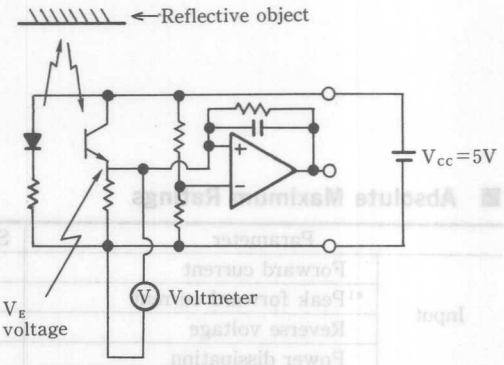


Fig. 5 Detecting Distance Characteristics





(Test Arrangement)



(Test Circuit Diagram)

7

GP2S01/GP2S01F Long Focal Distance Type Photointerrupter

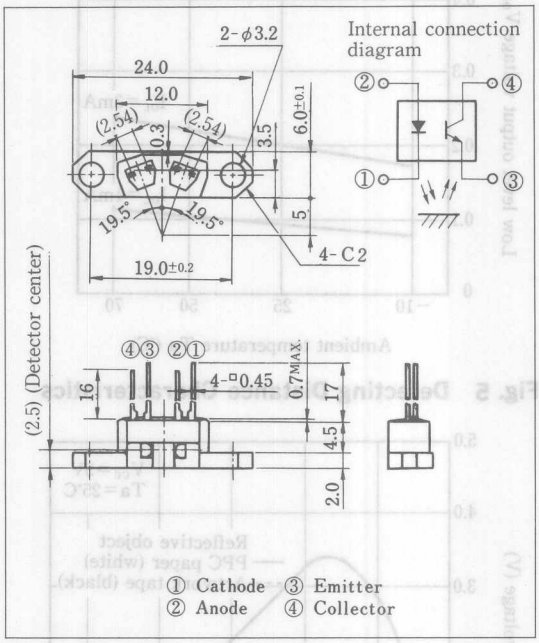
■ Features

1. Long focal distance
2. Visible light cut-off type : GP2S01F

■ Applications

1. Copiers, printers
2. Automatic vending machines, ticket vending machines
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1 Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2 Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage		V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Collector dark current		I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	*3 Current transfer ratio	GP2S01	CTR	I_F=20mA, V_{CE}=5V	1	—	10	%
		GP2S01F			1	—	4.5	
	Response time (Rise)	GP2S01	t_r	I_C=0.2mA, V_{CE}=2V, R_L=1kΩ	—	30	90	μs
		GP2S01F			—	30	120	
	Response time (Fall)	GP2S01	t_f		—	40	120	μs
		GP2S01F			—	40	160	
	*4 Leak current		I_{LEAK}	I_F=20mA, V_{CE}=5V	—	—	10	μA

*3 Test method : A reflective object shall be an OMS test card (white) specified by Sharp, and be 5.0mm away from the sensor

*4 Without reflective object

Fig. 1 Forward Current vs. Ambient Temperature

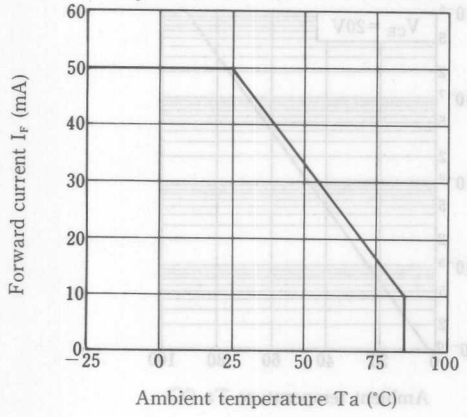


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

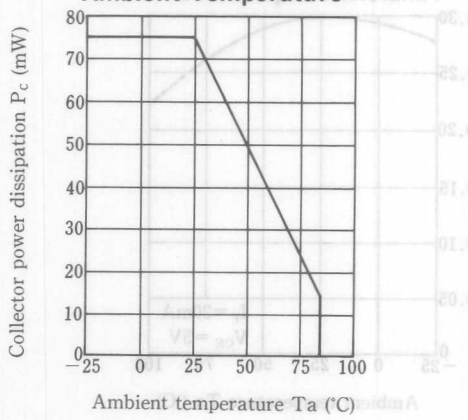


Fig. 3 Peak Forward Current vs. Duty Ratio

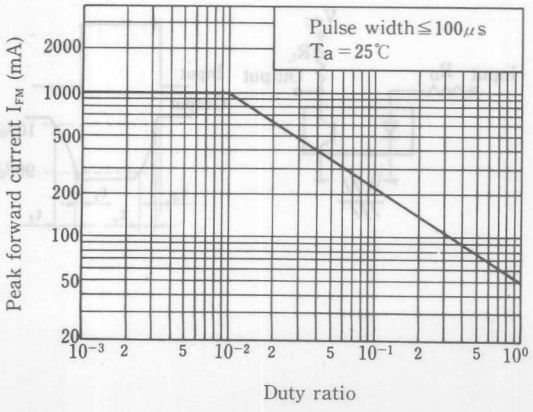
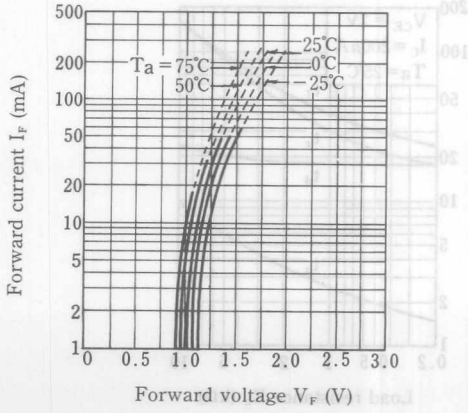


Fig. 4 Forward Current vs. Forward Voltage



7

Fig. 5 Collector Current vs. Forward Current

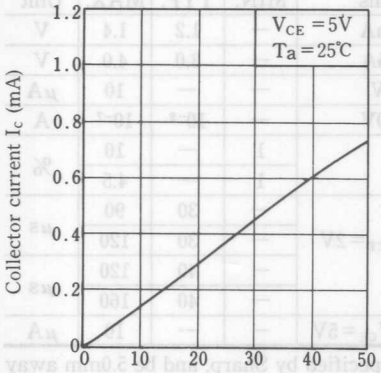


Fig. 6 Collector Current vs. Collector-emitter Voltage

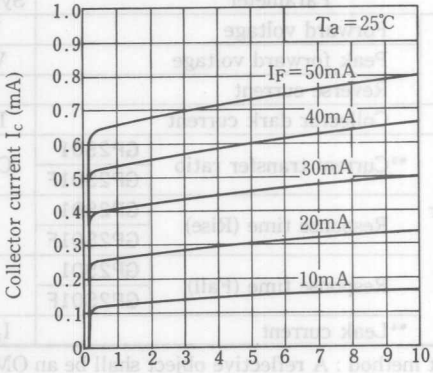


Fig. 7 Collector Current vs. Ambient Temperature

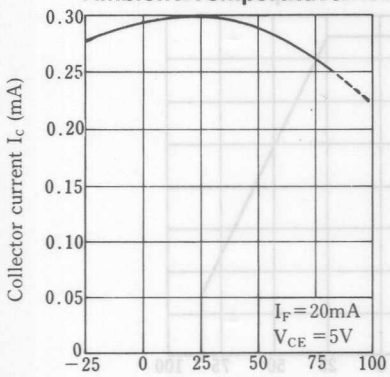


Fig. 8 Collector Dark Current vs. Ambient Temperature

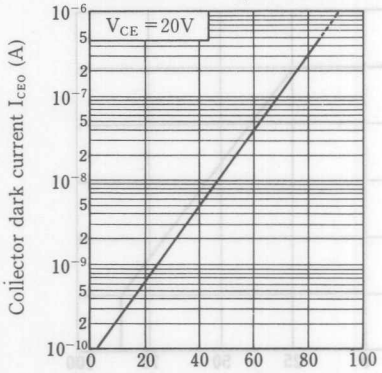
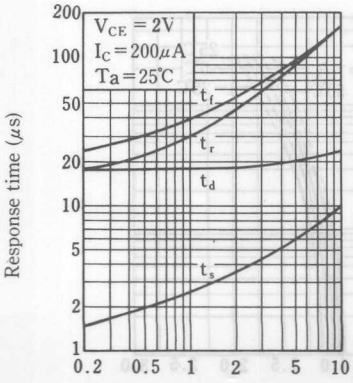


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

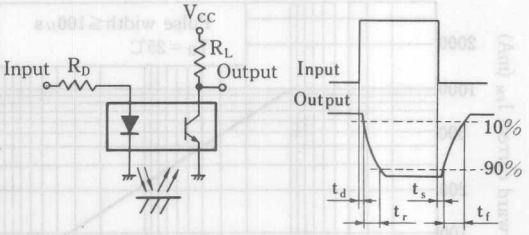


Fig. 10 Frequency Response

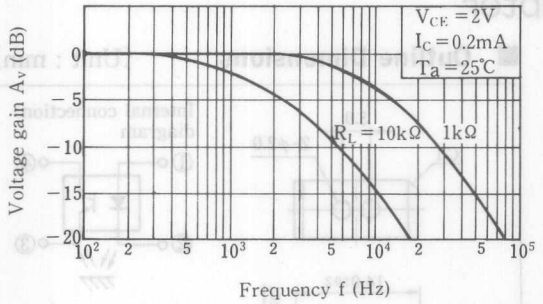


Fig. 11 Relative Collector Current vs. Distance between GP2S01(F) and Test Card

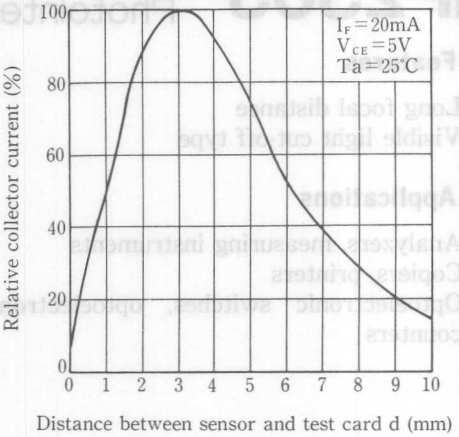
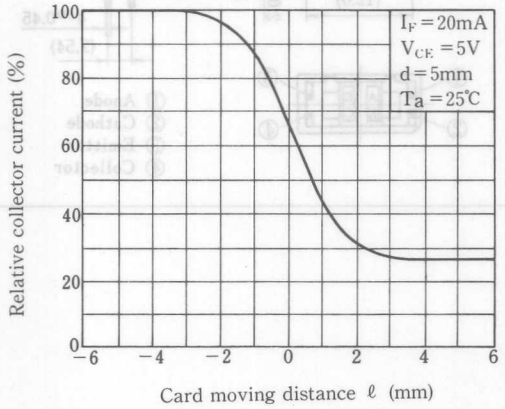


Fig. 12 Relative Collector Current vs. Card Moving Distance



Distance Characteristic Test Condition

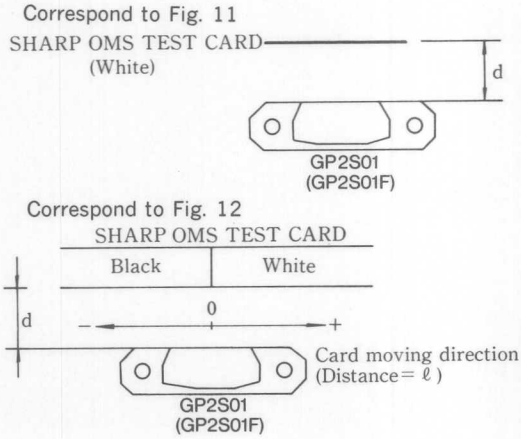
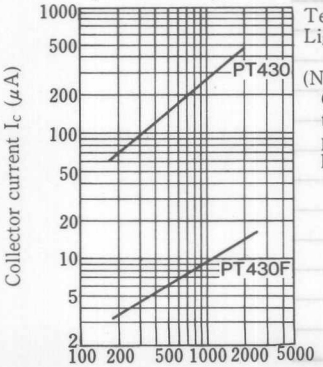


Fig.13 Collector Current vs. Illuminance (Reference)



Test Condition
Light source: White fluorescent lamp
Sharp FLR-40 SW/M

(Note)
Comparison between outputs of transparent resin molded type phototransistor (PT430) and visible light cut-off type (PT430F)

7

GP2S03 Long Focal Distance Type Photointerrupter

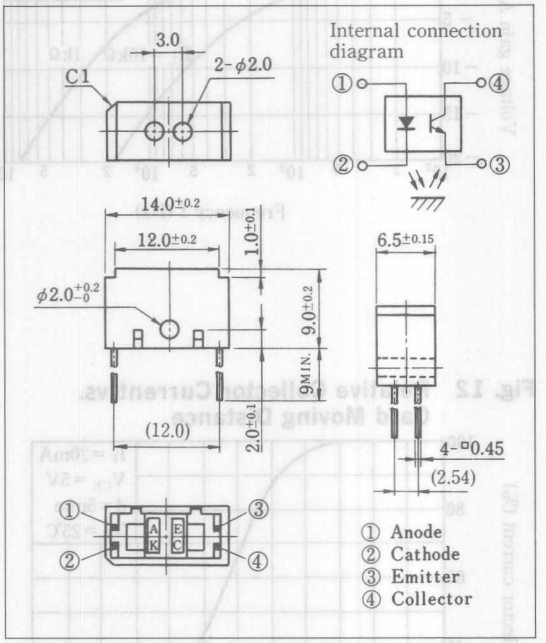
■ Features

1. Long focal distance
2. Visible light cut-off type

■ Applications

1. Analyzers, measuring instruments
2. Copiers, printers
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Operating tamperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*2Soldering temperature		T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 5 seconds

■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	10^{-9}	10^{-7}	A
Transfer characteristics	*3Current transfer ratio	CTR	I_F=20mA, V_{CE}=5V	0.8	—	—	%
	Response time (Rise)	t_r	I_C=200μA, V_{CE}=2V, R_L=1kΩ	—	30	90	μs
	Response time (Fall)	t_f		—	40	120	
	*4Leak current	I_{LEAK}	I_F=20mA, V_{CE}=5V	—	—	10	μA

*3 Test method : A reflective object shall be an OMS test card (white) specified by Sharp, and be 5.0mm away from the sensor.
*4 Without reflective object

Fig. 1 Forward Current vs. Ambient Temperature

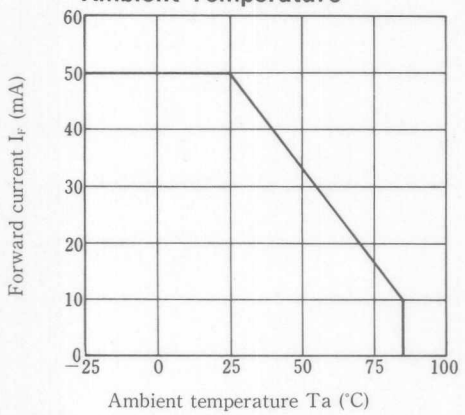


Fig. 2 Collector Power Dissipation vs. Ambient Temperaure

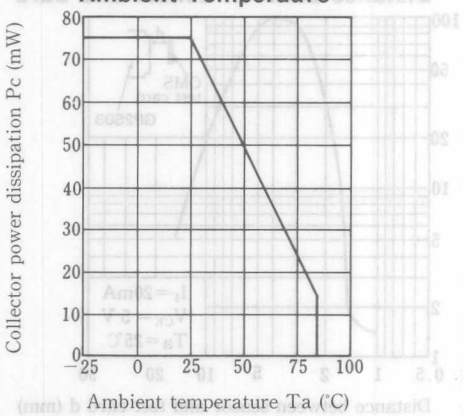


Fig. 3 Peak Forward Current vs. Duty Ratio

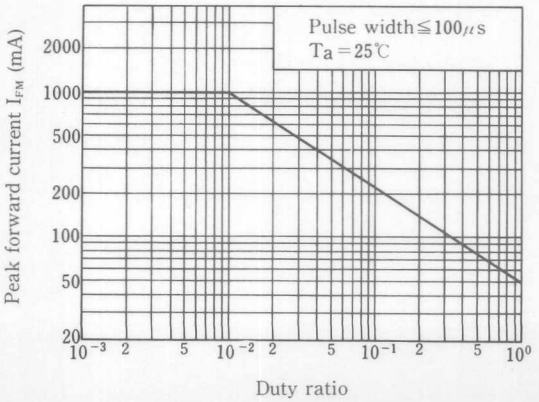
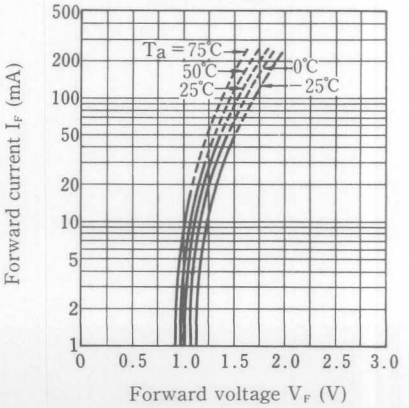


Fig. 4 Forward Current vs. Forward Voltage



7

Fig. 5 Collector Current vs. Forward Current

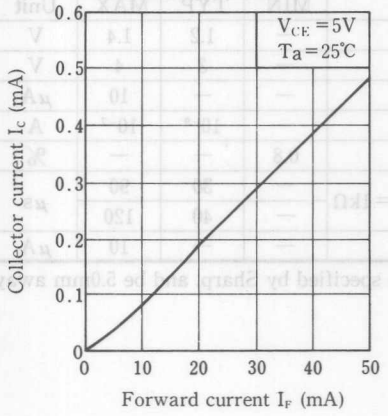


Fig. 6 Collector Current vs. Collector-emitter Voltage

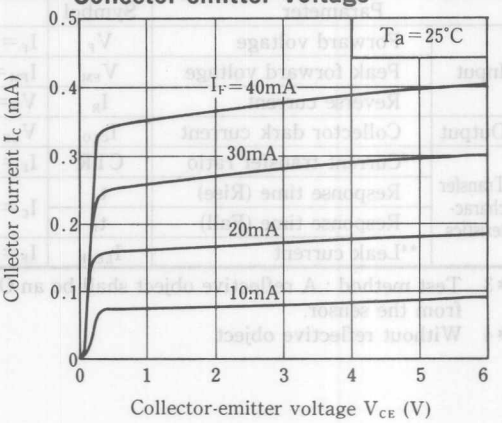
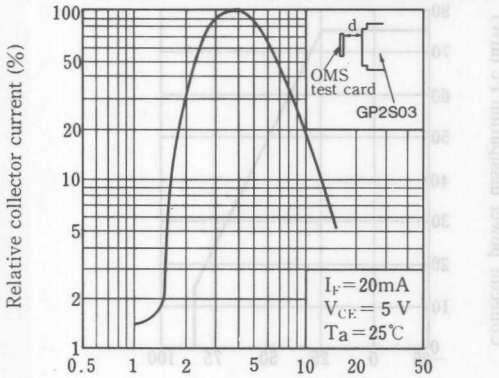


Fig. 7 Relative Collector Current vs. Distance between Sensor and Card



GP2S04/GP2S06/GP2S07 /GP2S09/GP2S10

Subminiature Photointerrupter

■ Features

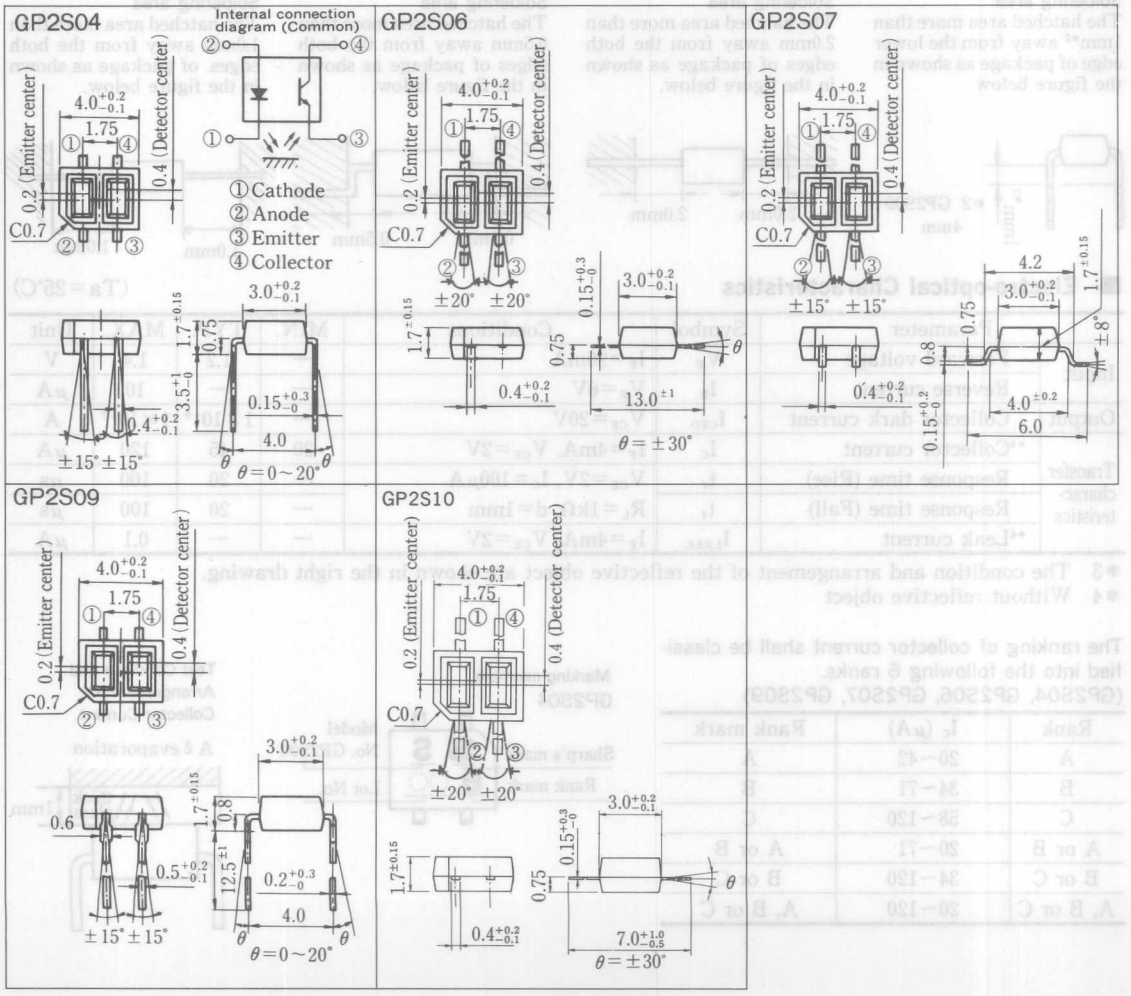
1. Compact and thin
   GP2S04 : Compact DIP type
   GP2S06 : Flat lead type
   GP2S07 : Mini-flat package type
   GP2S09 : Compact DIP, long lead type
   GP2S10 : Short flat lead type
2. Optical detection distance : 0.8~1mm
3. Visible light cut-off type

■ Applications

1. Cassette tape recorders, VCRs
2. Floppy disk drives
3. Various microcomputerized control equipment

■ Outline Dimensions

(Unit : mm)



7

■ Absolute Maximum Ratings

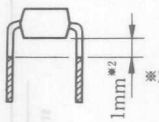
(Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P_D	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+85	°C
Storage temperature		T_{stg}	−40～+100	°C
*1Soldering temperature		T_{sol}	260	°C

*1 Within 5 seconds (Soldering areas for each model are shown below.)

GP2S04, GP2S09

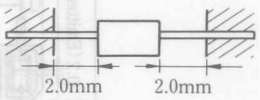
Soldering area
The hatched area more than 1mm*2 away from the lower edge of package as shown in the figure below.



*2 GP2S09 : 4mm

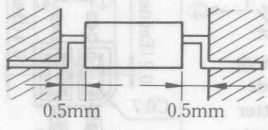
GP2S06

Soldering area
The hatched area more than 2.0mm away from the both edges of package as shown in the figure below.



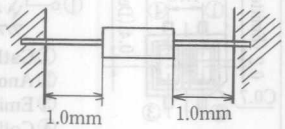
GP2S07

Soldering area
The hatched area more than 0.5mm away from the both edges of package as shown in the figure below.



GP2S10

Soldering area
The hatched area more than 1.0mm away from the both edges. of package as shown in the figure below.



■ Electro-optical Characteristics

(Ta=25°C)

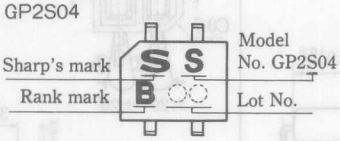
Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=6V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V	—	1×10^{-9}	1×10^{-7}	A
Transfer characteristics	*3Collector current	I_C	I_F=4mA, V_{CE}=2V	20	45	120	μA
	Response time (Rise)	t_r	V_{CE}=2V, I_C=100μA	—	20	100	μs
	Response time (Fall)	t_f	R_L=1kΩ, d=1mm	—	20	100	μs
	*4Leak current	I_{LEAK}	I_F=4mA, V_{CE}=2V	—	—	0.1	μA

*3 The condition and arrangement of the reflective object are shown in the right drawing.
*4 Without reflective object

The ranking of collector current shall be classified into the following 6 ranks.
(GP2S04, GP2S06, GP2S07, GP2S09)

Rank	I_C (μA)	Rank mark
A	20～42	A
B	34～71	B
C	58～120	C
A or B	20～71	A or B
B or C	34～120	B or C
A, B or C	20～120	A, B or C

Marking example
GP2S04



Test Conditon and Arrangement for Collector Current

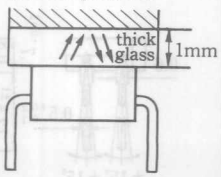


Fig. 1 Forward Current vs. Ambient Temperature

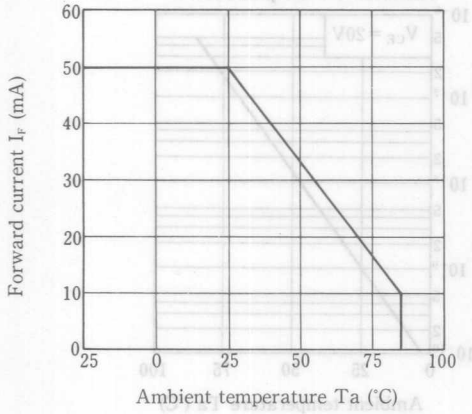


Fig. 2 Power Dissipation vs. Ambient Temperature

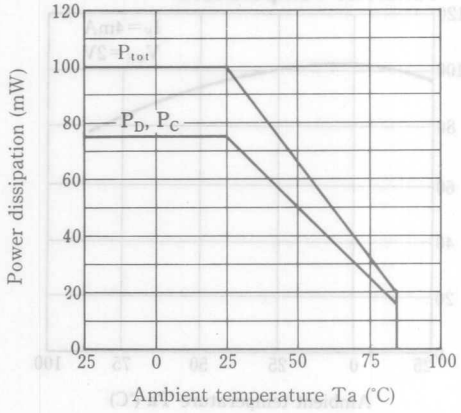


Fig. 3 Forward Current vs. Forward Voltage

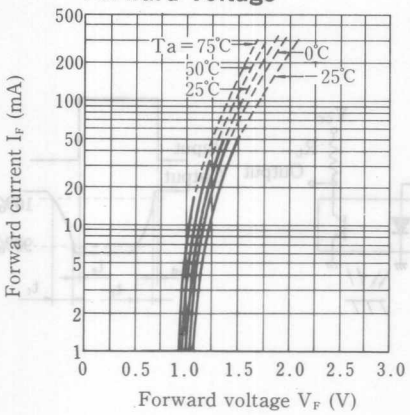


Fig. 4 Collector Current vs. Forward Voltage

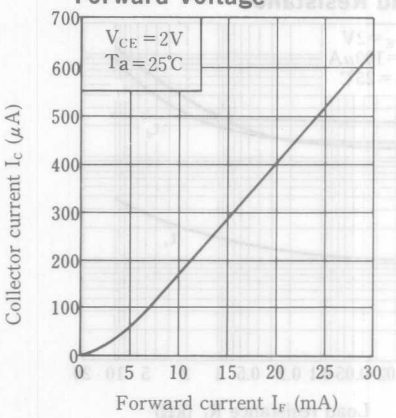
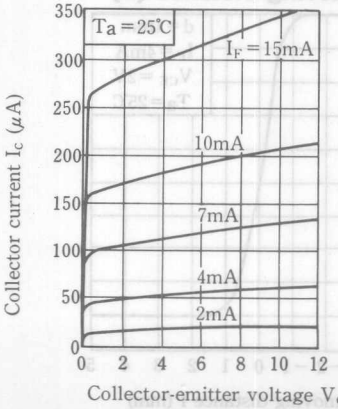


Fig. 5 Collector Current vs. Collector-emitter Voltage



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Fig. 6 Relative Collector Current vs. Ambient Temperature

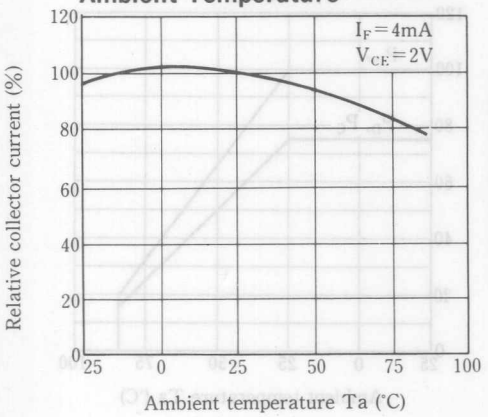


Fig. 7 Collector Dark Current vs. Ambient Temperature

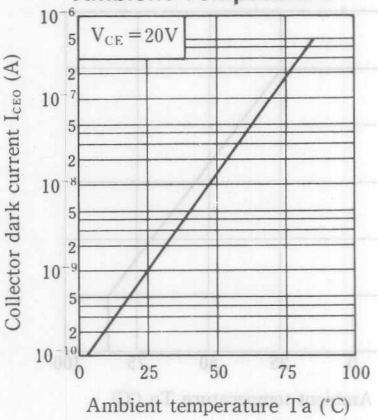
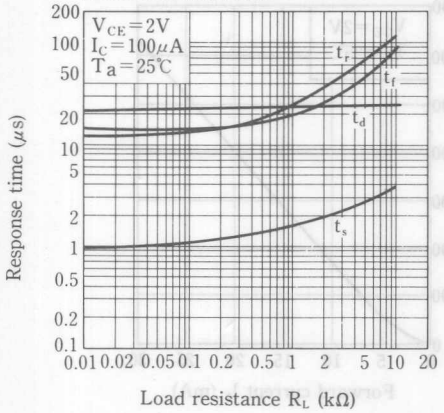


Fig. 8 Response Time vs. Load Resistance



Test Circuit for Response Time

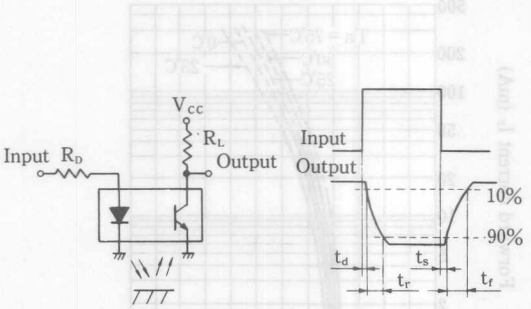


Fig. 9 Relative Collector Current vs. Distance between GP2S04 and Card

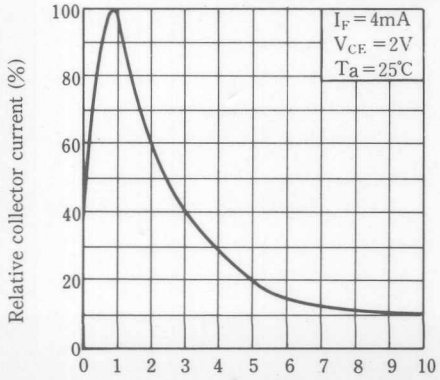


Fig. 10 Relative Collector Current vs. Card Moving Distance (1)

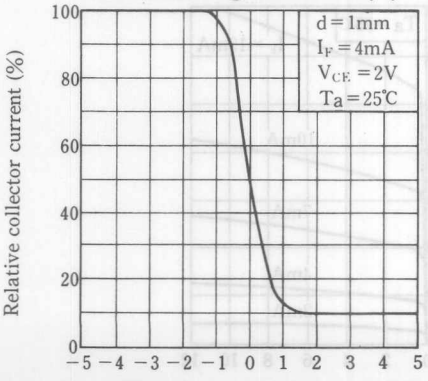
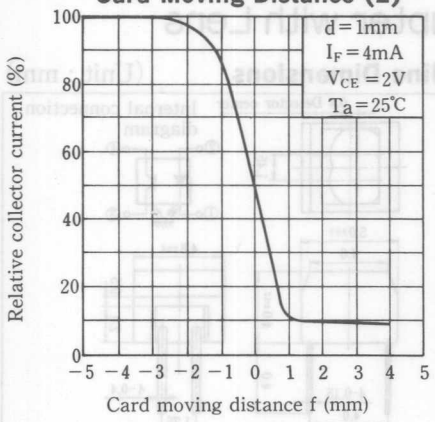


Fig. 11 Relative Collector Current vs. Card Moving Distance (2)



Test Condition for Distance & Detecting Position Characterittics

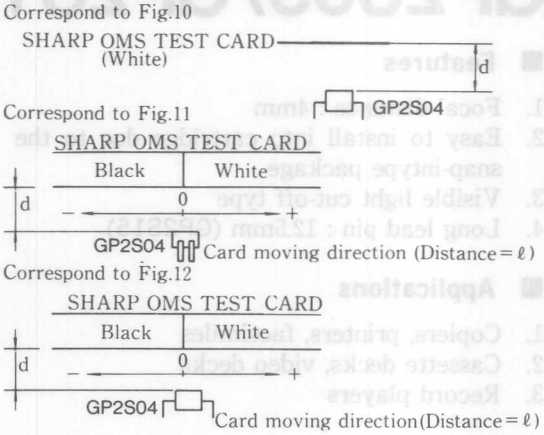


Fig. 12 Frequency Response

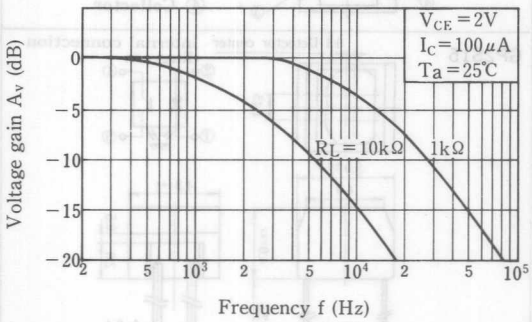
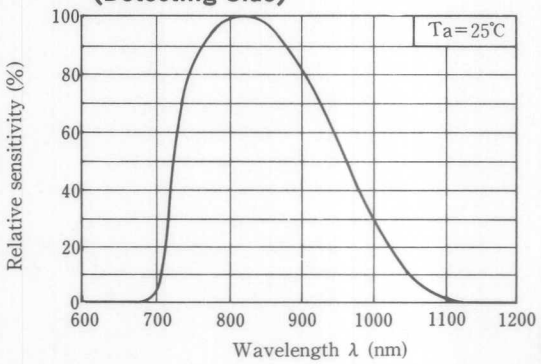


Fig. 13 Spectral Sensitivity (Detecting Side)



7

GP2S05/GP2S15 Subminiature Photointerrupter with Lens

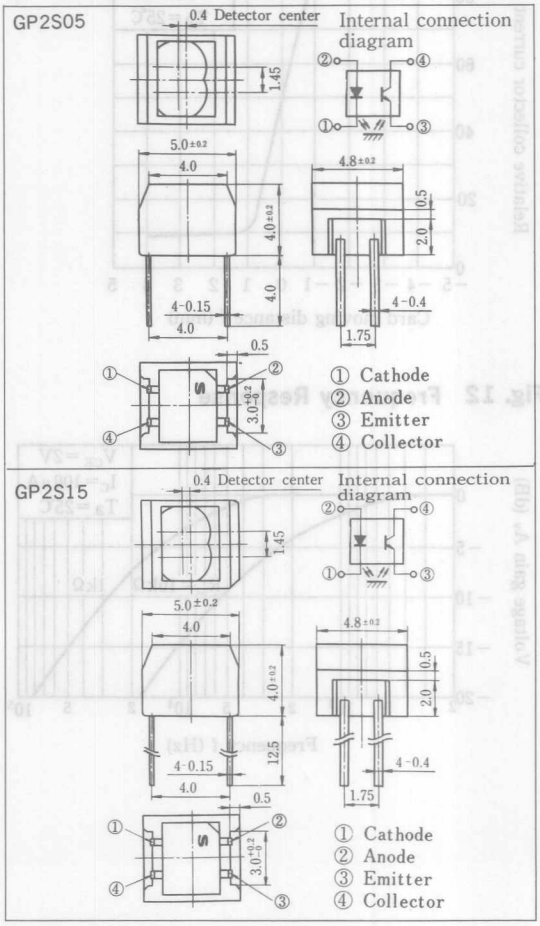
■ Features

1. Focal distance : 4mm
2. Easy to install into cartridge due to the snap-intype package
3. Visible light cut-off type
4. Long lead pin : 12.5mm (GP2S15)

■ Applications

1. Copiers, printers, facsimiles
2. Cassette decks, video decks
3. Record players

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
Total power dissipation		P_{tot}	100	mW
Operating temperature		T_{opr}	−25～+75	°C
Storage temperature		T_{stg}	−40～+80	°C
*1 Soldering temperature		T_{sol}	260	°C

*1 For 5 seconds at the position of 1mm from the bottom face of resin package

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions		MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA		—	1.2	1.4	V
	Reverse current	I_R	V_R=3V		—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=20V		—	10^{-9}	10^{-7}	A
Transfer characteristics	*2Collector current	CTR	V_{CE}=5V, I_F=20mA	GP 2S05	1.4	—	12	%
				GP 2S15	0.5	—	12	%
	Response time (Rise)	t_r	I_C=100μA, V_{CE}=2V		—	20	100	μs
	Response time (Fall)	t_f	R_L=1kΩ, d=4mm		—	20	100	μs
	*3Leak current	I_{LEAK}	I_F=20mA, V_{CE}=5V		—	8	40	μA

*2 The condition and arrangement of the reflective object are shown below.
*3 Without reflective object

Test Condition and Arrangement for Collector Current

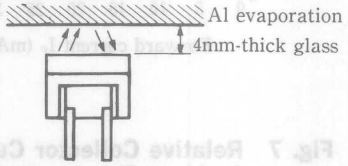


Fig. 1 Forward Current vs. Ambient Temperature

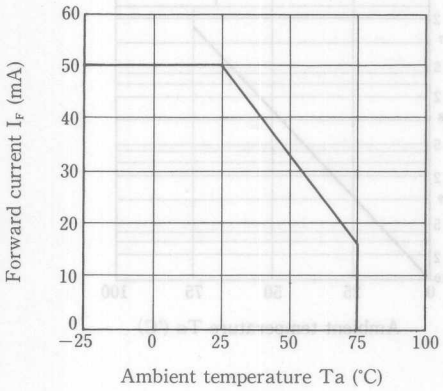


Fig. 2 Power Dissipation vs. Ambient Temperature

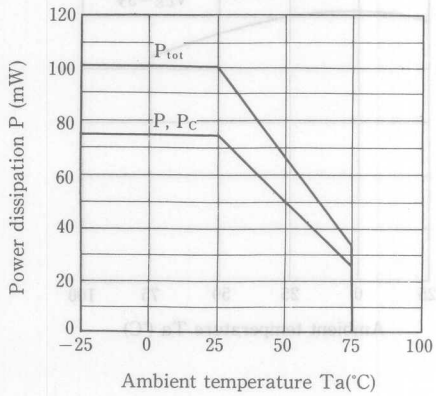


Fig. 3 Peak Forward Current vs. Duty Ratio

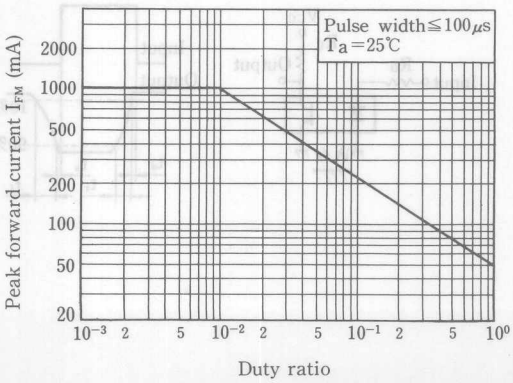
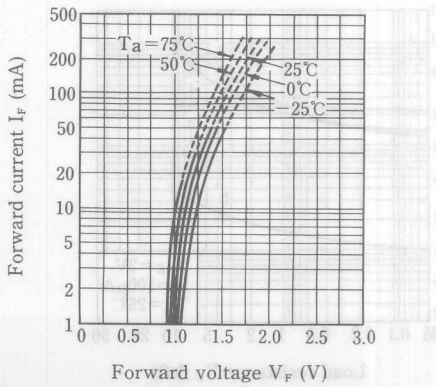


Fig. 4 Forward Current vs. Forward Voltage



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Fig. 5 Collector Current vs. Forward Current

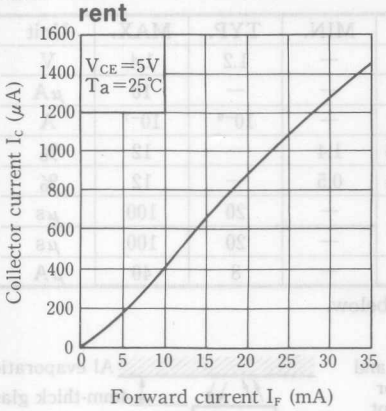


Fig. 6 Collector Current vs. Collector-emitter Voltage

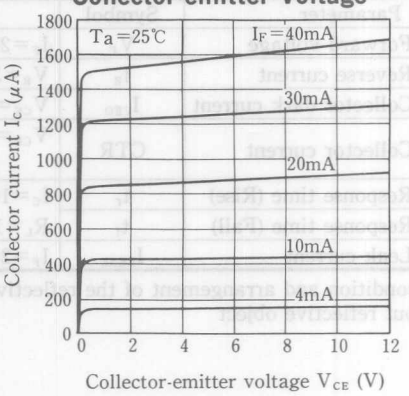


Fig. 7 Relative Collector Current vs. Ambient Temperature

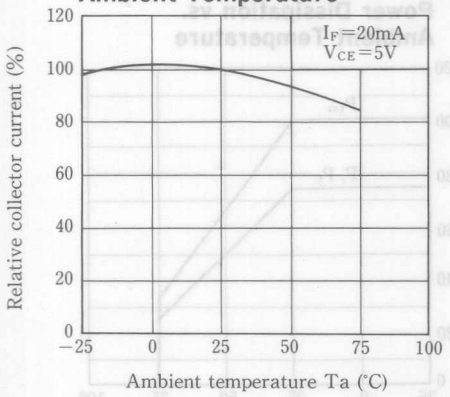


Fig. 8 Collector Dark Current vs. Ambient Temperature

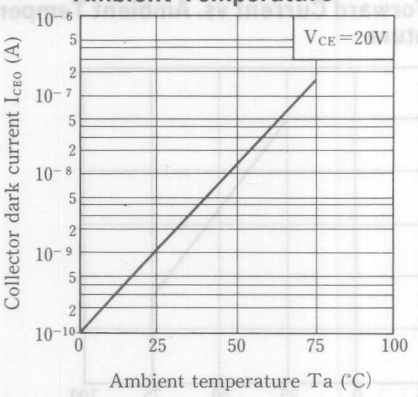
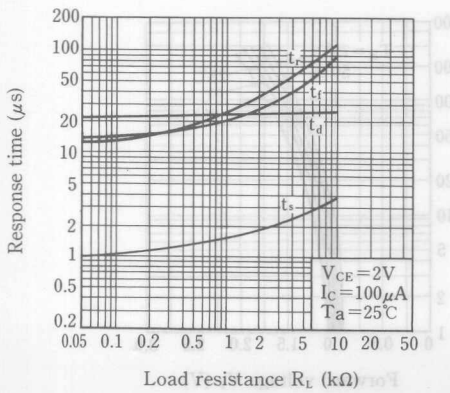


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

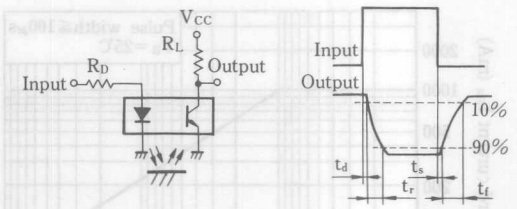


Fig.10 Relative Collector Current vs. Distance between GP2S05 (GP2S15) and Evaporation Glass

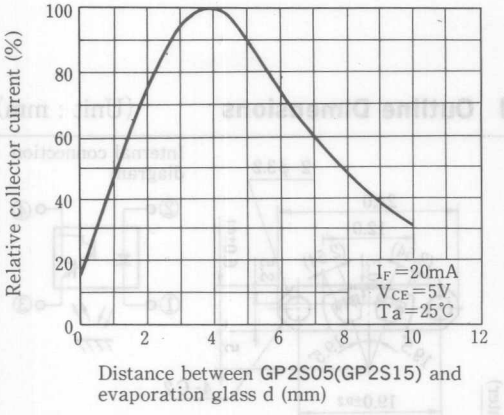


Fig. 11 Relative Collector Current vs. Card Moving Distance (1)

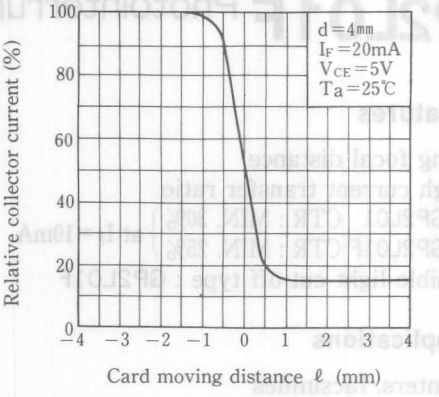
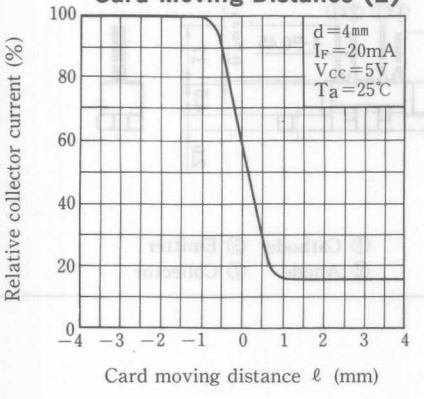
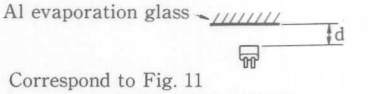


Fig. 12 Relative Collector Current vs. Card Moving Distance (2)

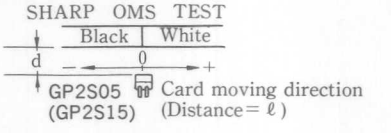


Distance Characteristic Test Condition

Correspond to Fig. 10



Correspond to Fig. 11



Correspond to Fig. 12

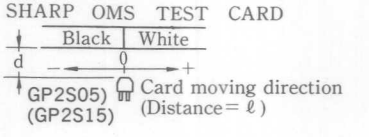


Fig. 13 Frequency Response

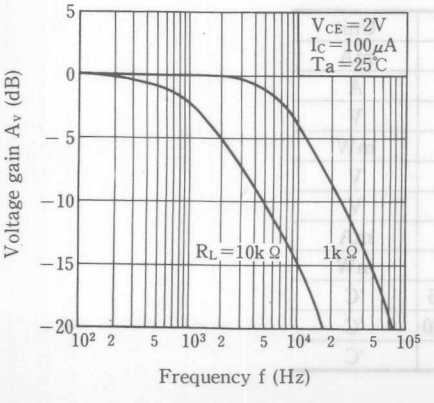
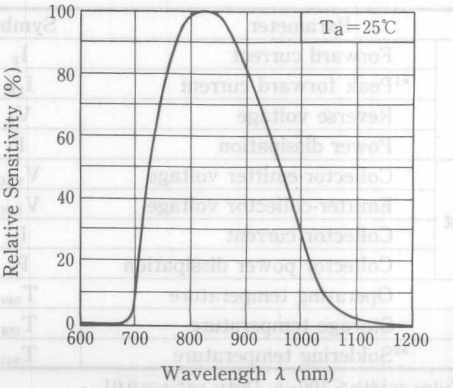


Fig. 14 Spectral Sensitivity (Detecting Side)



7

GP2L01/GP2L01F High Sensitivity, Long Focal Distance Type Photointerrupter

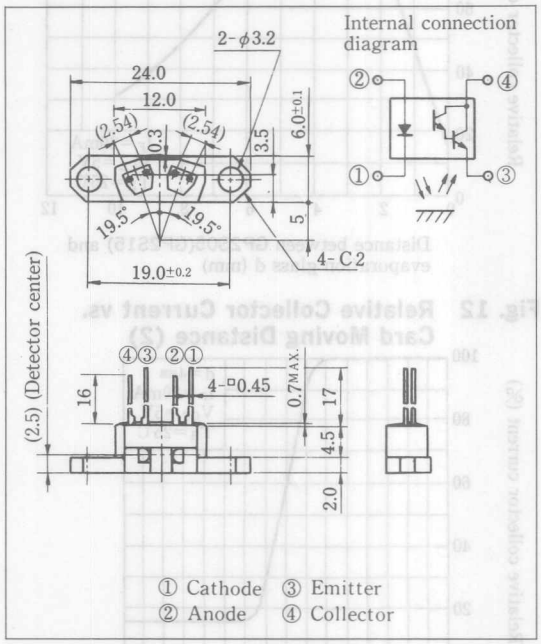
■ Features

1. Long focal distance
2. High current transfer ratio
   GP2L01 CTR : MIN. 30%
   GP2L01F CTR : MIN. 25%
   } at I_F=10mA
3. Visible light cut-off type : GP2L01F

■ Applications

1. Printers, facsimiles
2. Automatic vending machines, ticket vending machines
3. Optoelectronic switches, optoelectronic counters

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	40	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, Duty ratio=0.01
*2 For 3 seconds

■ Electro-optical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=20mA	—	1.2	1.4	V
	Peak forward voltage		V_{FM}	I_{FM}=0.5A	—	3.0	4.0	V
	Reverse current		I_R	V_R=3V	—	—	10	μA
Output	Collector dark current		I_{CEO}	V_{CE}=10V, I_F=0	—	—	10^{-6}	A
Trasfer characteristics	*3Current transfer ratio	GP2L01	CTR	I_F=10mA, V_{CE}=2V	30	—	—	%
		GP2L01F			25	—	250	%
	Response time (Rise)		t_r	I_C=10mA, V_{CE}=2V, R_L=100Ω	—	80	400	μs
	Response time (Fall)		t_f		—	70	350	μs
	*4Leak current		I_{LEAK}	I_F=10mA, V_{CE}=2V	—	—	100	μA

*3 Test method : A reflective object shall be an OMS test card (white) specified by Sharp, and be 5.0mm away from the sensor.

*4 Without reflective object

Fig. 1 Forward Current vs. Ambient Temperature

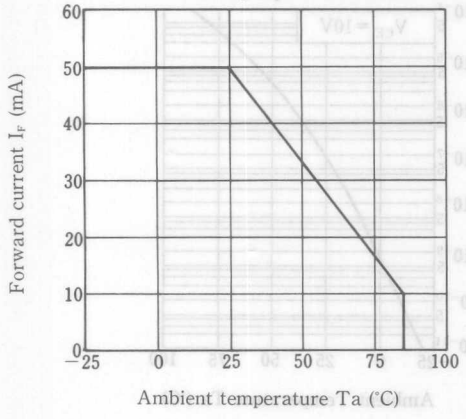


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

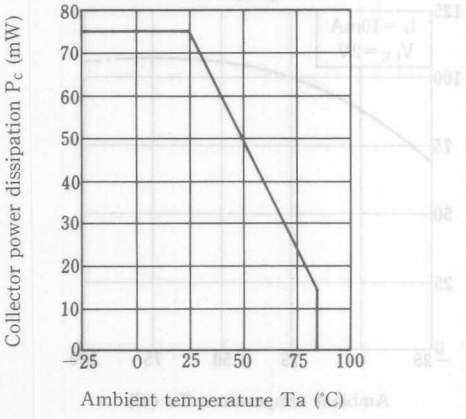


Fig. 3 Peak Forward Current vs. Duty Ratio

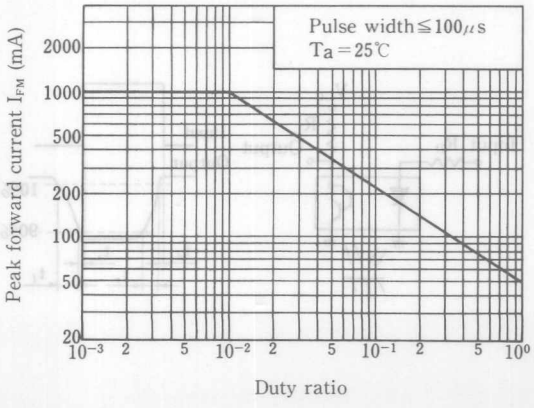
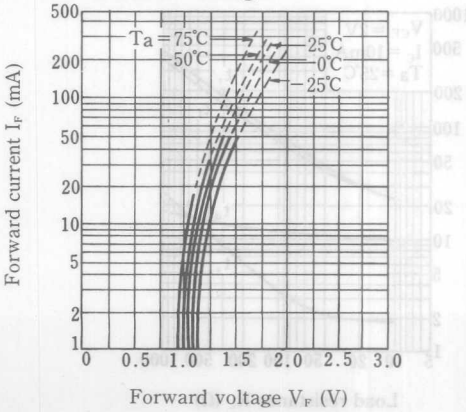


Fig. 4 Forward Current vs. Forward Voltage



7

Fig. 5 Collector Current vs. Forward Current

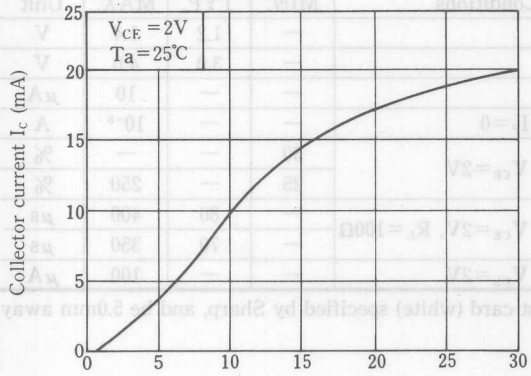


Fig. 6 Collector Current vs. Collector-emitter Voltage

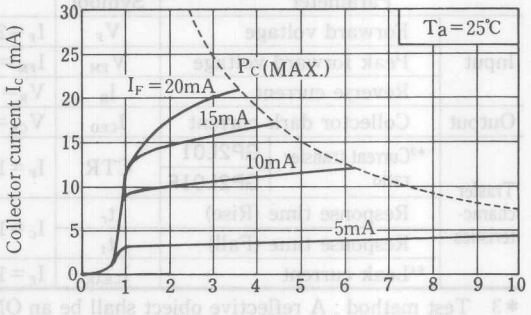


Fig. 7 Relative Collector Current vs. Ambient Temperature

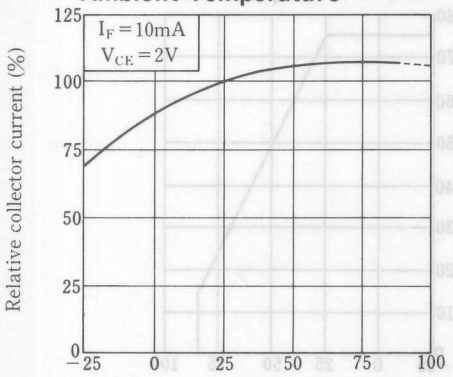


Fig. 8 Collector Dark Current vs. Ambient Temperature

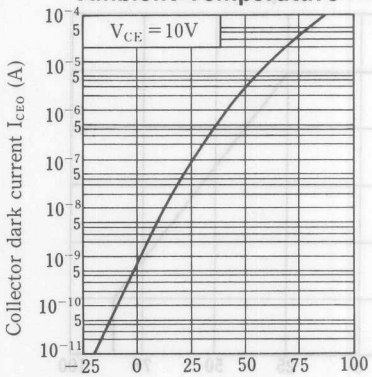
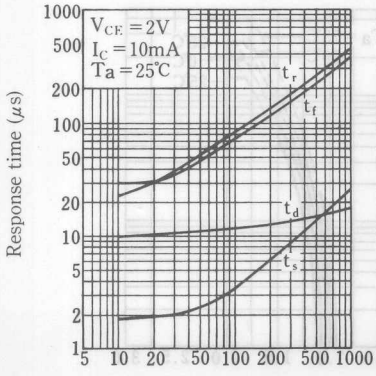


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

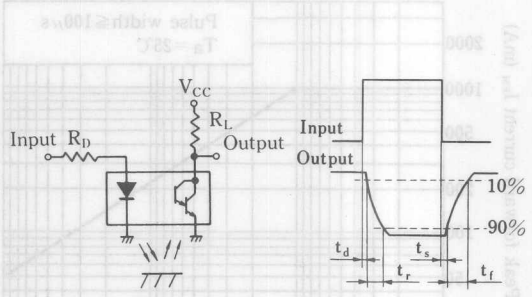


Fig. 10 Frequency Response

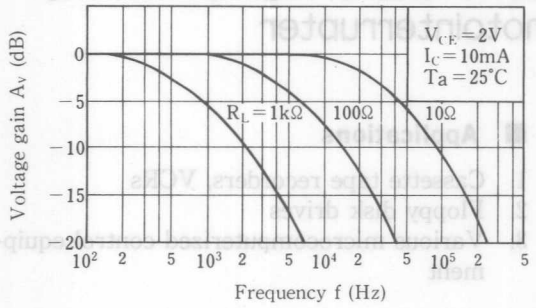


Fig. 11 Relative Collector Current vs. Distance between GP2L01(F) and Card

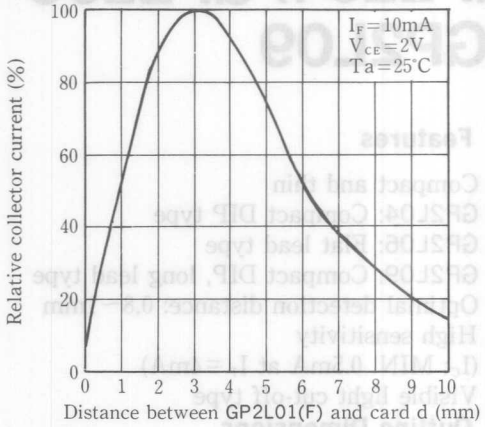
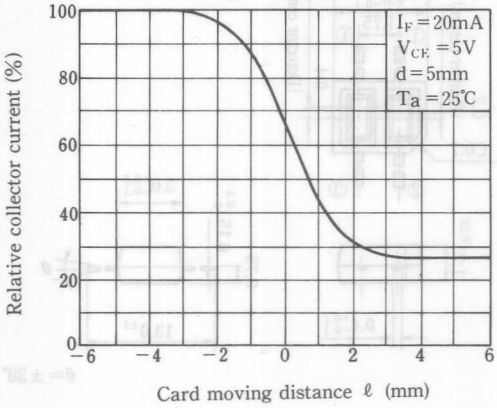


Fig. 12 Relative Collector Current vs. Card Moving Distance



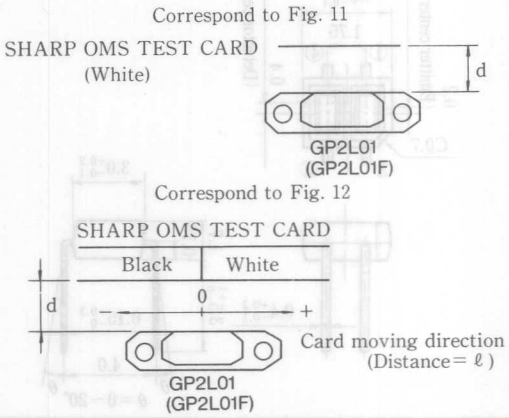
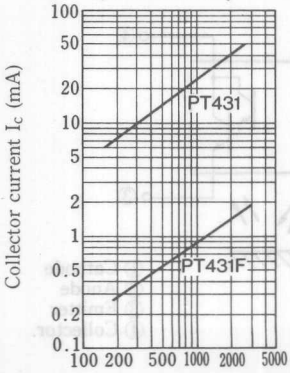


Fig. 13 Collector Current vs. Illuminance (Reference)



(Test Condition)
V_{CE} = 2V, Ta = 25°C
Light source : White flourescent lamp
Sharp FLR-40 SW/M

(Note) Comparison between outputs of transparent resin molded type phototransistor (PT431) and visible light cut-off type (PT431F)

7

GP2L04/GP2L06 /GP2L09

Subminiature, High Sensitivity Photointerrupter

■ Features

1. Compact and thin
   GP2L04: Compact DIP type
   GP2L06: Flat lead type
   GP2L09: Compact DIP, long lead type
2. Optimal detection distance: 0.8~1mm
3. High sensitivity
   (I_C: MIN. 0.5mA at I_F=4mA)
4. Visible light cut-off type

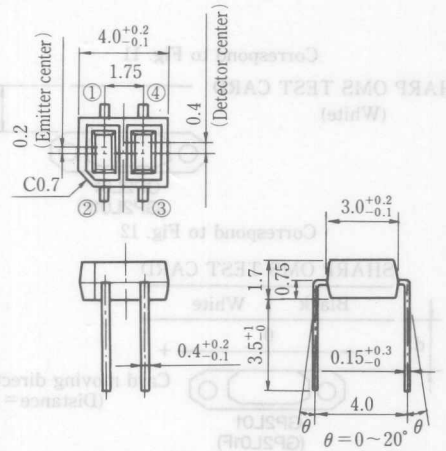
■ Applications

1. Cassette tape recorders, VCRs
2. Floppy disk drives
3. Various microcomputerized control equipment

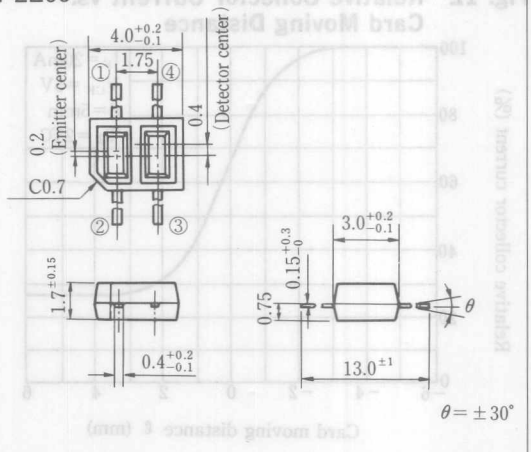
■ Outline Dimensions

(Unit : mm)

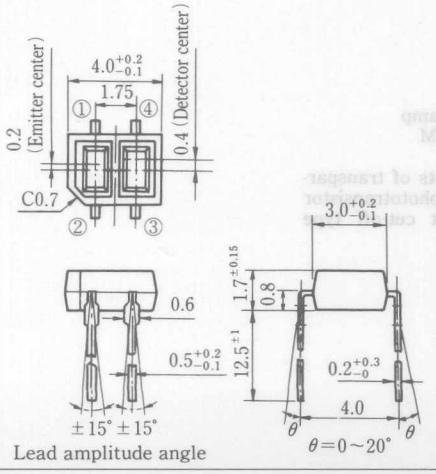
GP2L04



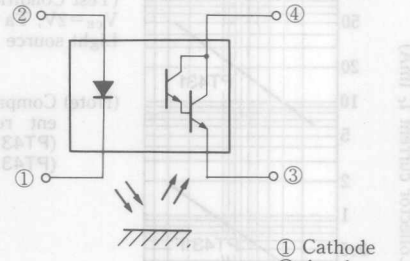
GP2L06



GP2L09



Internal connection diagram (Common to 3 models)

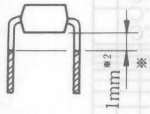


■ Absolute Maximum Ratings (Ta=25°C)

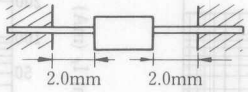
Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	P_D	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	50	mA
	Collector power dissipation	P_C	75	mW
	Total power dissipation	P_{tot}	100	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*1Soldering temperature	T_{sol}	260	°C

*1 Within 5 seconds (Soldering areas are shown below.)

GP2L04, GP2L09
Soldering area
The hatched area more than 1mm*2 away from the lower edge of package as shown in the drawing below.



GP2L06
Soldering area
The hatched area more than 2.0mm away from the both edges of package as shown in the drawing below.



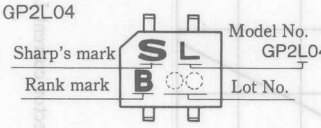
■ Electro-optical Characteristics (Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	I_R	V_R=6V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V, I_F=0	—	—	1×10^{-6}	A
Transfer characteristics	*3Collector current	I_C	V_{CE}=2V, I_F=4mA	0.5	3.0	15.0	mA
	Response time (Rise)	t_r	V_{CE}=2V, I_C=10mA	—	80	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	70	400	μ
	*4Leak current	I_{LEAK}	I_F=4mA, V_{CE}=5V	—	—	5.0	μA

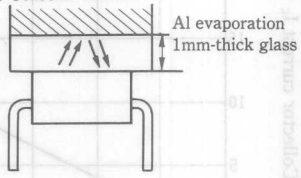
*3 The condition and arrangement of the reflective object are shown in the right drawing.
*4 Without reflective object

Rank	I_C (mA)	Rank mark
A	0.5～1.9	A
B	1.45～5.4	B
C	4.0～15.0	C
AB	0.5～5.4	A or B
BC	1.45～15.0	B or C
ABC	0.5～15.0	A, B or C

Marking Example
GP2L04



Test Condition and Arrangement for Collector Current



7

Fig. 1 Forward Current vs. Ambient Temperature

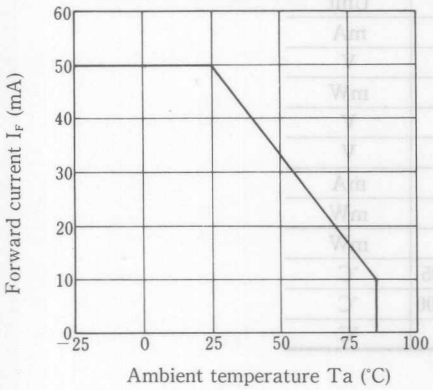


Fig. 2 Power Dissipation vs. Ambient Temperature

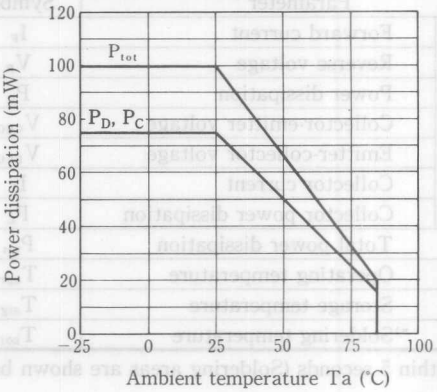


Fig. 3 Peak Forward Current vs. Duty Ratio

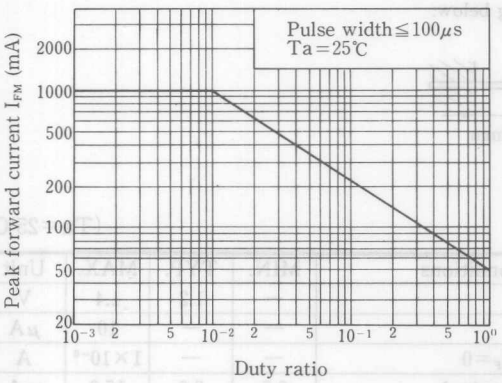


Fig. 4 Forward Current vs. Forward Voltage

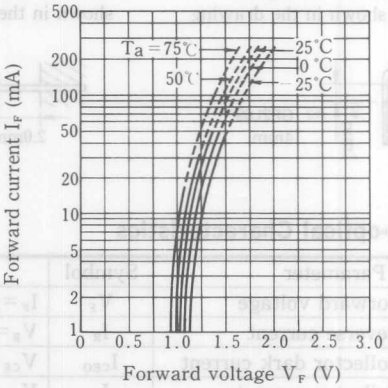


Fig. 5 Collector Current vs. Forward Current

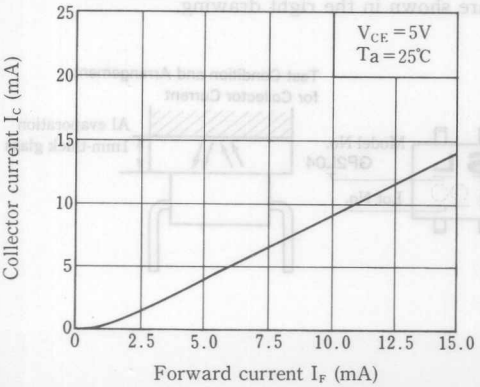


Fig. 6 Collector Current vs. Collector-emitter Voltage

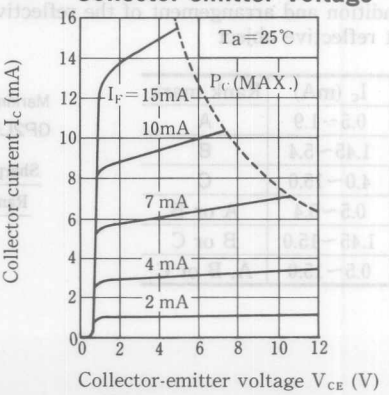


Fig. 7 Relative Collector Current vs. Ambient Temperature

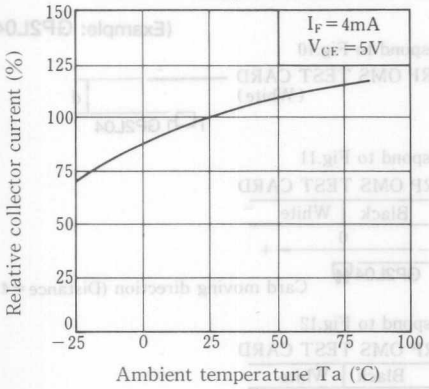


Fig. 8 Collector Dark Current vs. Ambient Temperature

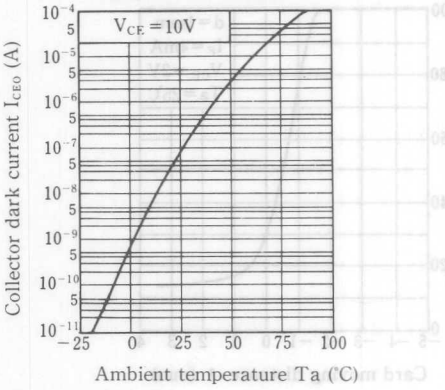
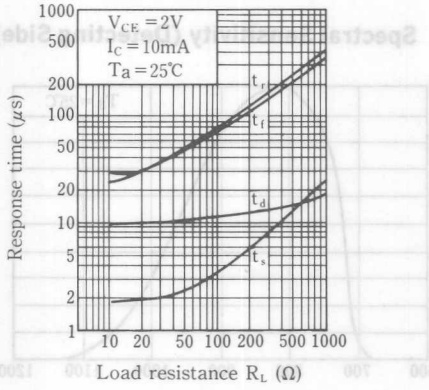


Fig. 9 Response Time vs. Load Resistance



Test Circuit for Response Time

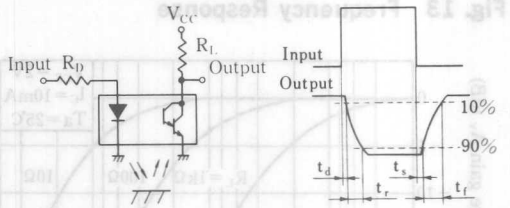


Fig. 10 Relative Collector Current vs. Distance between GL2L04 and Card

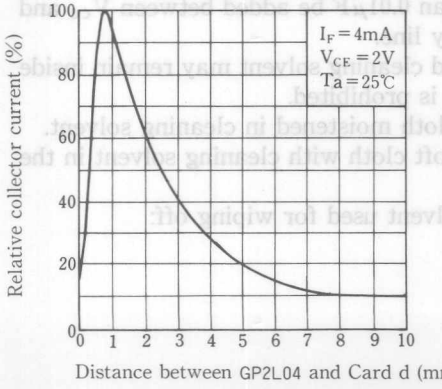
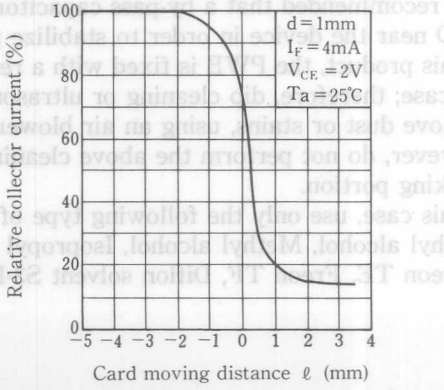
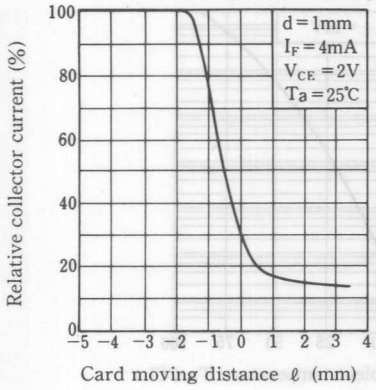


Fig. 11 Relative Collector Current vs. Card Moving Distance (1)



7

Fig. 12 Relative Collector Current vs. Card Moving Distance (2)

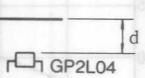


Test Condition for Distance & Detecting Position Characteristics

(Example: GP2L04)

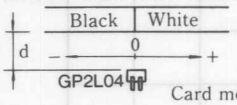
Correspond to Fig.10

SHARP OMS TEST CARD (White)



Correspond to Fig.11

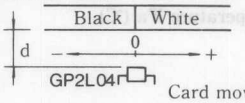
SHARP OMS TEST CARD



Card moving direction (Distance = ℓ)

Correspond to Fig.12

SHARP OMS TEST CARD



Card moving direction (Distance = ℓ)

Fig. 13 Frequency Response

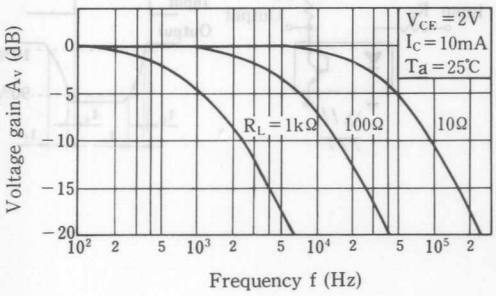
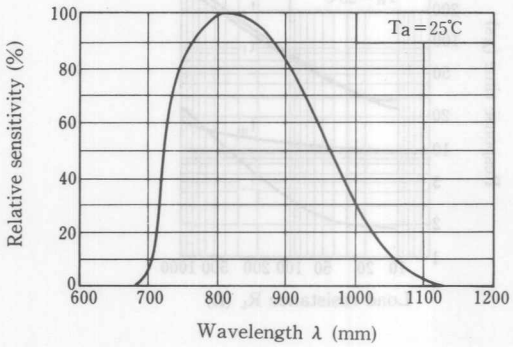


Fig. 14 Spectral Sensitivity (Detecting Side)



■ Precautions for Use

- It is recommended that a by-pass capacitor of more than 0.01μF be added between V_{CC} and GND near the device in order to stabilize power supply line.
- In this product, the PWB is fixed with a rear cover, and cleaning solvent may remain inside the case; therefore, dip cleaning or ultrasonic cleaning is prohibited.
- Remove dust or stains, using an air blower or a soft cloth moistened in cleaning solvent. However, do not perform the above cleaning using a soft cloth with cleaning solvent in the marking portion.

  In this case, use only the following type of cleaning solvent used for wiping off:
  Ethyl alcohol, Methyl alcohol, Isopropyl alcohol,
  Freon TE, Freon TF, Diflon solvent S3-E

GP2L20L/GP2L20R Compact, Thin Type Photointerrupter

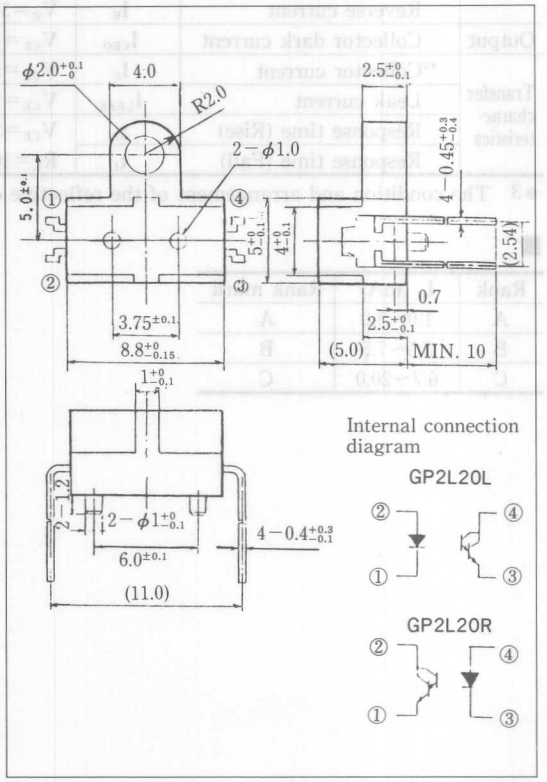
■ Features

1. Correspond to Prism system
2. Compact and thin
3. Either-side mounting type

■ Application

1. Digital audio tape recorder

■ Outline Dimensions (Unit : mm)



■ Absolute Maximum Ratings (Ta=25°C)

	Parameter	Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	*1Peak forward current	I_{FM}	1	A
	Reverse voltage	V_R	6	V
	Power dissipation	P	75	mW
Output	Collector-emitter voltage	V_{CEO}	35	V
	Emitter-collector voltage	V_{ECO}	6	V
	Collector current	I_C	20	mA
	Collector power dissipation	P_C	75	mW
	Operating temperature	T_{opr}	−25～+85	°C
	Storage temperature	T_{stg}	−40～+100	°C
	*2Soldering temperature	T_{sol}	260	°C

*1 Pulse width≦100μs, duty ratio=0.01
*2 For 5 seconds

7

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=20mA	—	1.25	1.4	V
	Peak forward voltage	V_{FM}	I_{FM}=0.5A	—	3	4	V
	Reverse current	I_R	V_R=3V	—	—	10	μA
Output	Collector dark current	I_{CEO}	V_{CE}=10V	—	—	1	μA
Transfer characteristics	*3Collector current	I_C	V_{CE}=5V, I_F=20mA	1	—	20	mA
	Leak current	I_{LEAK}	V_{CE}=5V, I_F=20mA	—	—	5	μA
	Response time (Rise)	t_r	V_{CE}=2V, I_C=2mA	—	80	400	μs
	Response time (Fall)	t_f	R_L=100Ω	—	70	350	μs

*3 The condition and arrangement of the reflective object are shown in the right drawing.

■

Rank	I_C (mA)	Rank mark
A	1.0~3.0	A
B	2.5~7.5	B
C	6.7~20.0	C

Test Condition and Arrangment for Collector Current

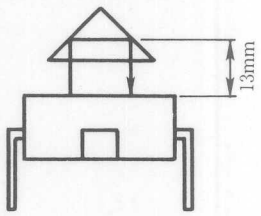


Fig. 1 Forward Current vs. Ambient Temperature

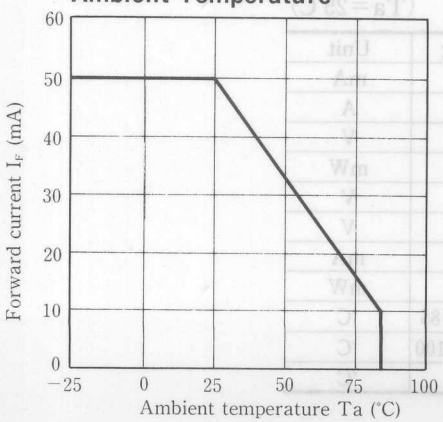


Fig. 2 Collector Power Dissipation vs. Ambient Temperature

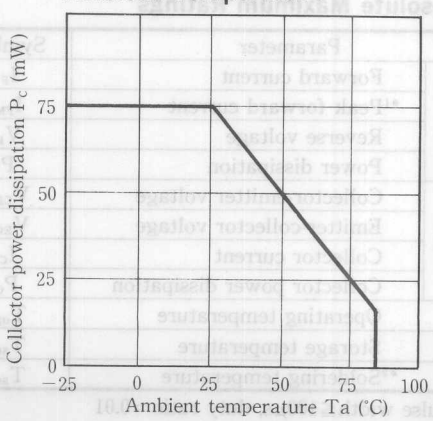


Fig. 3 Peak Forward Current vs. Duty Ratio

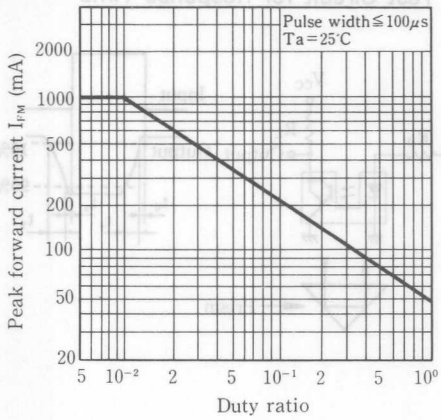


Fig. 4 Forward Current vs. Forward Voltage

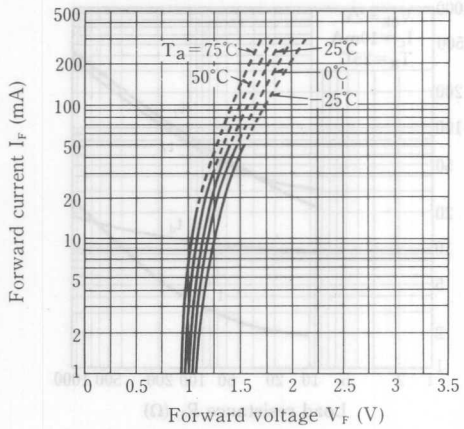


Fig. 5 Collector Current vs. Forward Current

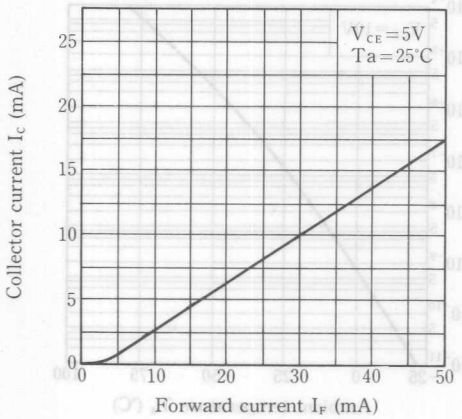


Fig. 6 Collector Current vs. Collector-emitter Voltage

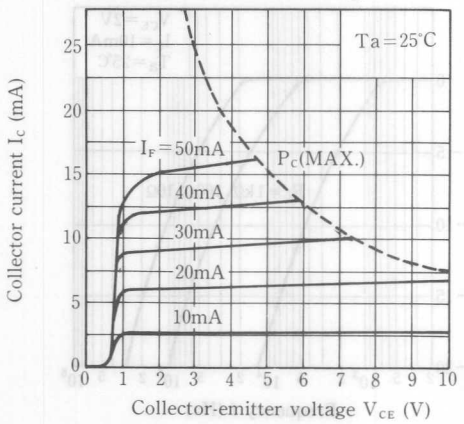
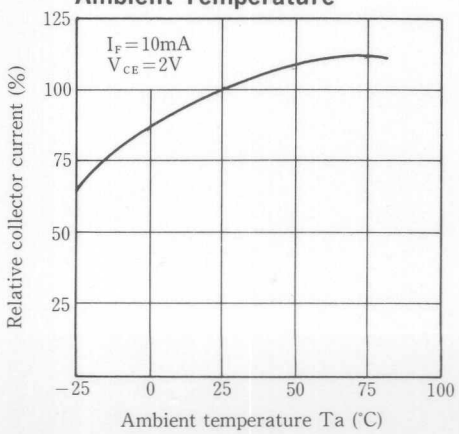
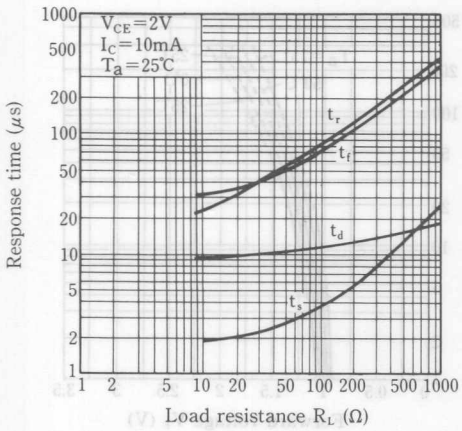


Fig. 7 Relative Collector Current vs. Ambient Temperature



7

Fig. 8 Response Time vs. Load Resistance



Test Circuit for Response Time

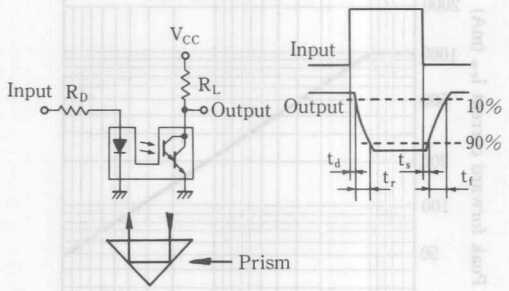


Fig. 9 Frequency Response

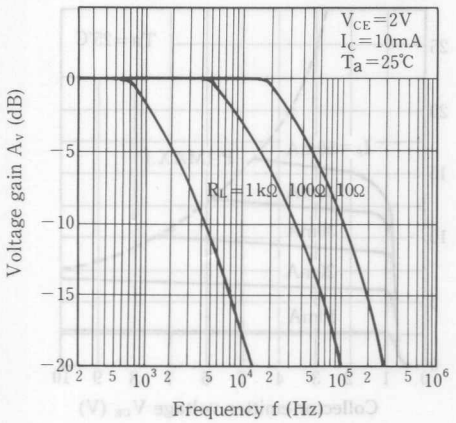
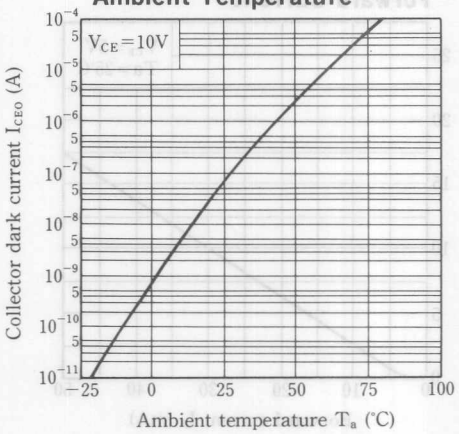


Fig. 10 Collector Dark Current vs. Ambient Temperature



GP2TD02 Tilt Sensor

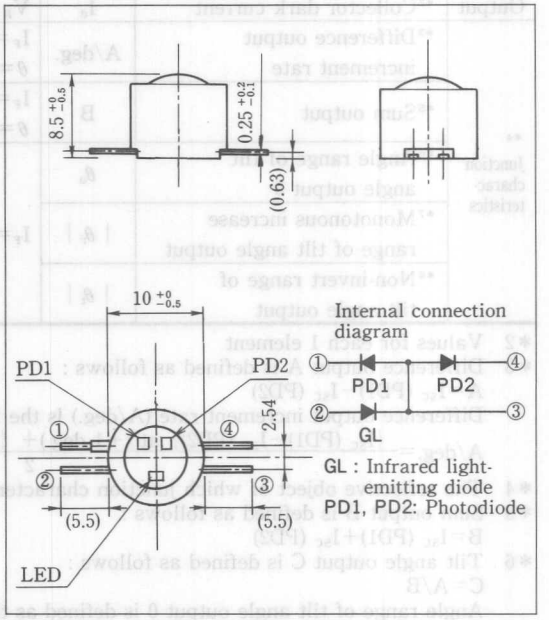
■ Features

1. With incorporating lens
2. Linear output in accordance with tilt

■ Applications

1. Optical video disk players
2. Magneto-optical disks

■ Outline Dimensions (Unit : mm)



7

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating	Unit
Input	Forward current	I_F	50	mA
	Reverse voltage	V_R	6	V
	Power dissipation	Pin	75	mW
Output	Reverse voltage	V_R	20	V
	Power dissipation	P_{out}	75	mW
	Operating temperature	T_{opr}	−10～+70	°C
	Storage temperature	T_{stg}	−25～+85	°C
	*1Soldering temperature	T_{sol}	260	°C

*1 For 5 seconds at the position of 2.0mm or more from the surface of resin edge.

■ Electro-optical Characteristics

(Ta=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	V_F	I_F=15mA	—	—	1.5	V
	Reverse current	I_R	V_R=6V	—	—	10	μA
Output	*2Collector dark current	I_d	V_R=10V	—	—	100	nA
*4 Junction characteristics	*3Difference output increment rate	A/deg.	I_F=15mA. H=11.82mm θ=−1~0~+1 deg.	1.15	2.7	14.3	μA/deg.
	*5Sum output	B	I_F=15mA. H=11.82mm θ=0 deg.	5.5	11.4	40.3	μA
	*6Angle range of tilt angle output 0	θ_o	I_F=15mA, H=11.82mm	−1	—	+1	deg.
	*7Monotonous increase range of tilt angle output	$\lvert\theta_r\rvert$		2.0	—	—	deg.
	*8Non-invert range of tilt angle output	$\lvert\theta_t\rvert$		5	—	—	deg.

*2 Values for each 1 element

*3 Difference output A is defined as follows :

$A=I_{SC}$ (PD1)$-I_{SC}$ (PD2)

Difference output increment rate (A/deg.) is the increment rate of current A at 1 deg.

$$A/deg.=-\frac{\{I_{SC}\ (PD1)-I_{SC}\ (PD2)\}\ \text{at}\ (+1\ deg.)+\{I_{SC}\ (PD2)-I_{SC}\ (PD1)\}\ \text{at}\ (-1\ deg.)}{2}$$

*4 The reflective object of which junction characteristics are given is a multi-layer coating mirror.

*5 Sum output B is defined as follows :

$B=I_{SC}$ (PD1)$+I_{SC}$ (PD2)

*6 Tilt angle output C is defined as follows :

C=A/B

Angle range of tilt angle output 0 is defined as the range of angles that makes C=0.

*7 Monotonous increase range of tilt angle output is the range of angles with respect to which C increases monotonously with the coordinate original point at the angle that makes C=0.

*8 Non-invert range of tilt angle output is the range of angles that don't make C negative.

Fig. 1 Forward Current vs. Ambient Temperature

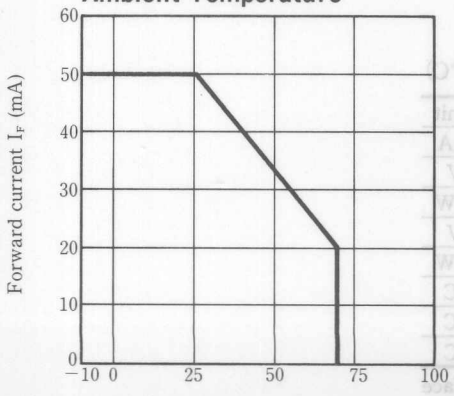


Fig. 2 Output Power Dissipation vs. Ambient Temperature

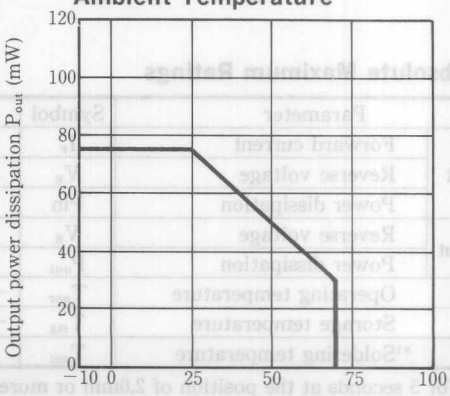


Fig. 3 Difference Output Characteristics

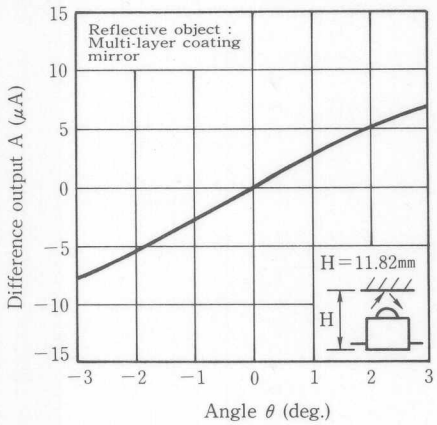


Fig. 4 Sum Output Characteristics

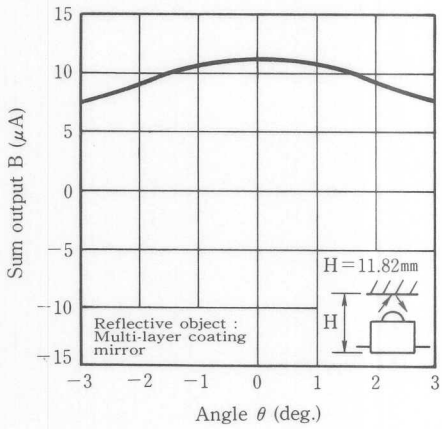
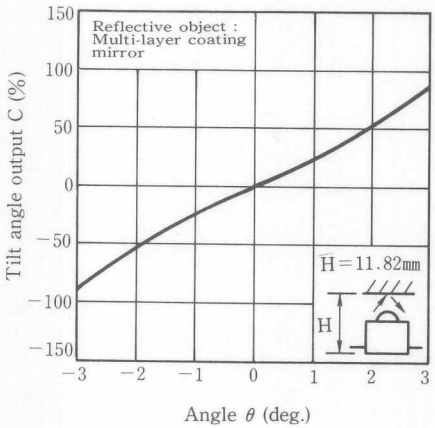
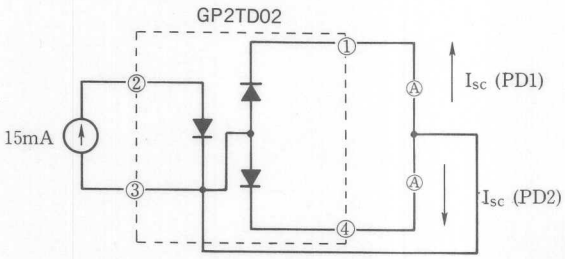


Fig. 5 Tilt Angle Output Characteristics

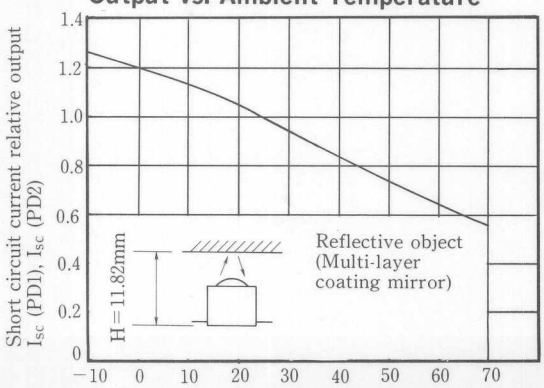


Test Circuit for Sum Output Characteristics, Difference Output Characteristics, Tilt Angle Output Characteristics

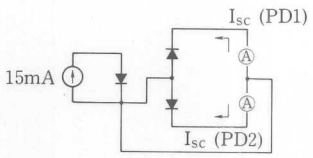


PD1, PD2: Photodiode

Fig. 6 Short Circuit Current Relative Output vs. Ambient Temperature



Test Circuit for Short Circuit Current Relative Output vs. Ambient Temperature



7

Fig. 3 Difference Output Characteristics

Fig. 4 Sum Output Characteristics

Fig. 5 Tilt Angle Output Characteristics

Test Circuit for Sum Output Characteristics, Difference Output Characteristics, Tilt Angle Output Characteristics

PD1, PD2: Photodiode

Fig. 6 Short Circuit Current Relative Output vs. Ambient Temperature

Test Circuit for Short Circuit Current Relative Output vs. Ambient Temperature

Solid State Relays

8

S101D01/S101D02 S201D01/S201D02

16-Pin DIP Type SSR for Low Power Control

■ Features

1. Compact
   (16-pin dual-in-line package type)
2. RMS on-state current I_T: 1.2Arms
3. Built-in zero-cross circuit
   (S101D02, S201D02)

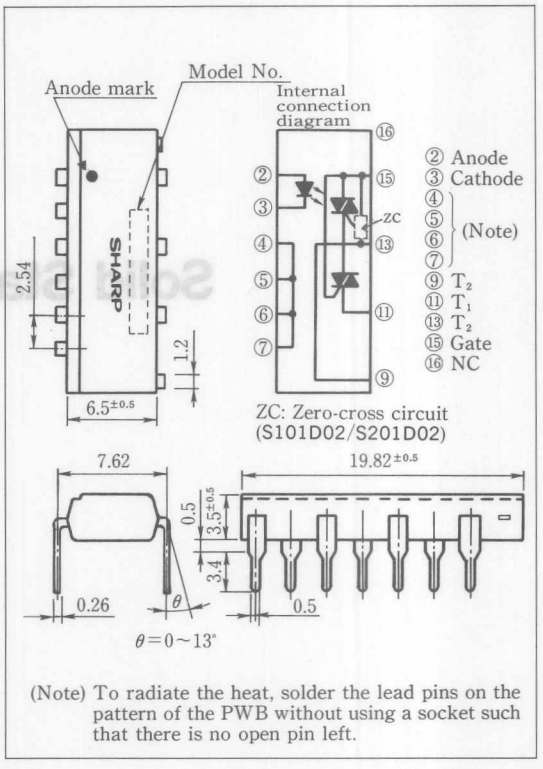
■ Applications

1. Fan heaters
2. Microwave ovens
3. Refrigerators
4. Air conditioners

■ Power Supply Lines

	For 100V lines	For 200V lines
For phase control No built-in zero-cross circuit	S101D01	S201D01
Built-in zero-cross circuit	S101D02	S201D02

■ Outline Dimensions (Unit : mm)



(Note) To radiate the heat, solder the lead pins on the pattern of the PWB without using a socket such that there is no open pin left.

■ Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Rating S101D01/S101D02	Rating S201D01/S201D02	Unit
Input	Forward current	I_F	50	50	mA
	Reverse voltage	V_R	6	6	V
Output	RMS on-state current	I_T	1.2	1.2	Arms
	*1Peak one cycle surge current	I_{surge}	12	12	A
	Repetitive peak off-state voltage	V_{DRM}	400	600	V
*2Isolation voltage		V_{iso}	4,000	4,000	Vrms
Operating temperature		T_{opr}	−25~+85	−25~+85	°C
Storage temperature		T_{stg}	−40~+125	−40~+125	°C
*3Soldering temperature		T_{sol}	260	260	°C

*1 50Hz, sine wave
*2 RH=40~60%, AC 60Hz for 1 minute
*3 For 10 seconds

■ Electrical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage		V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current		I_R	V_R=3V	—	—	10^{-5}	A
Output	Repetitive Peak off-state current	S101D01/S101D02	I_{DRM}	V_{DRM}=400V	—	—	10^{-4}	A
		S201D01/S201D02		V_{DRM}=600V	—	—	10^{-4}	A
	On-state voltage		V_T	I_T=1.2A	—	—	1.7	V
	Holding current		I_H	R_L=100Ω	—	—	25	mA
	Zero-cross voltage	S101D02/S201D02	V_{OX}	Resistance load, I_F=15mA	—	—	35	V
	Critical rate of rise of off-state voltage	S101D01/S101D02	dv/dt	$V_{DRM}=1/\sqrt{2}\cdot 400V$	200	—	—	V/μs
		S201D01/S201D02		$V_{DRM}=1/\sqrt{2}\cdot 600V$	100	—	—	V/μs
Transfer characteristics	Minimum trigger current		I_{FT}	V_D=6V, R_L=100Ω	—	—	10	mA
	Isolation resistance		R_{ISO}	DC500V, RH=40~60%	5×10^{10}	10^{11}	—	Ω
	Turn-on time		t_{on}	V_D=6V, R_L=100Ω, I_F=20mA	—	—	100	μs

Fig. 1 RMS On-state Current vs. Ambient Temperature

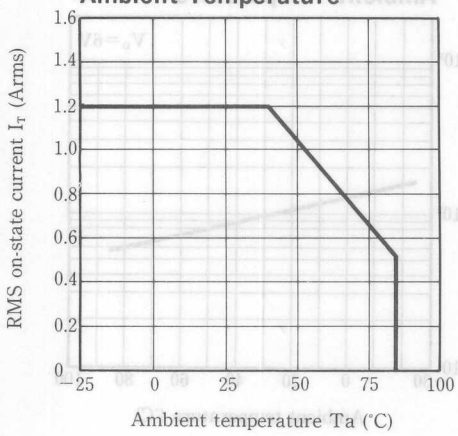


Fig. 2 Forward Current vs. Ambient Temperature

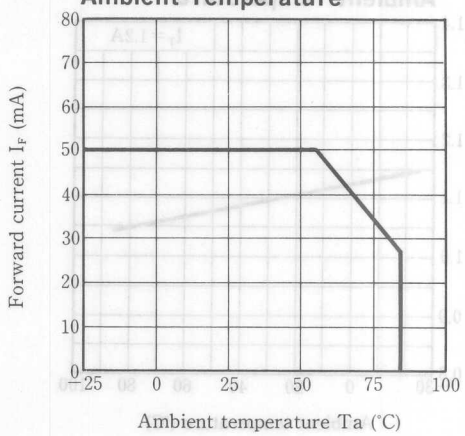


Fig. 3 Forward Current vs. Forward Voltage

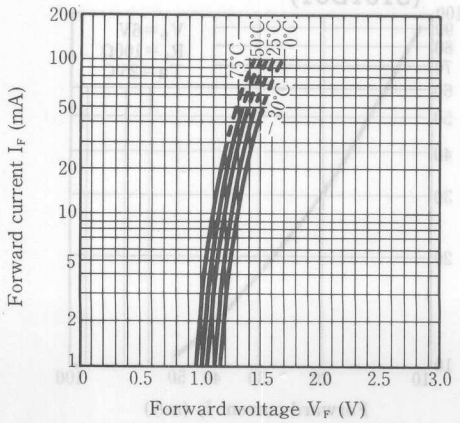
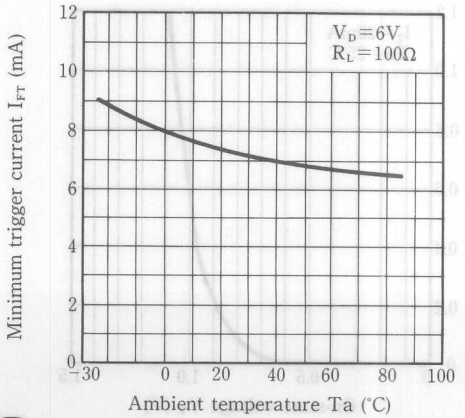


Fig. 4 Minimum Trigger Current vs. Ambient Temperature (S101D01)



8

Fig. 5 Minimum Trigger Current vs. Ambient Temperature (S101D02, S201D02)

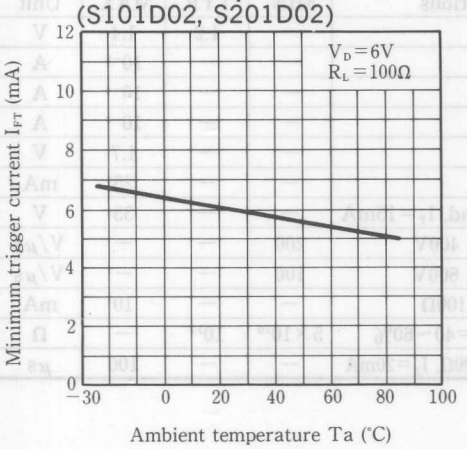


Fig. 6 Minimum Trigger Current vs. Ambient Temperature (S201D01)

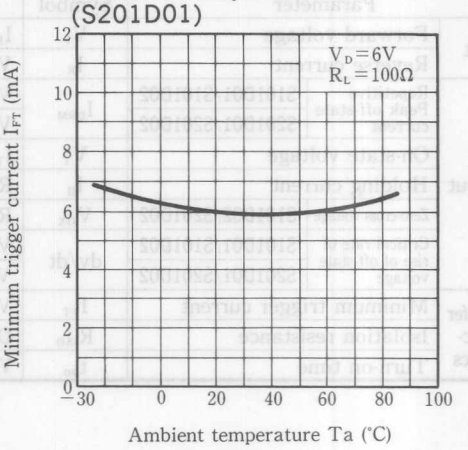


Fig. 7 On-state Voltage vs. Ambient Temperature

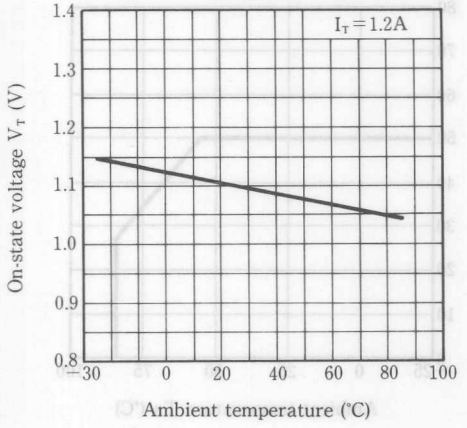


Fig. 8 Holding Current vs. Ambient Temperature

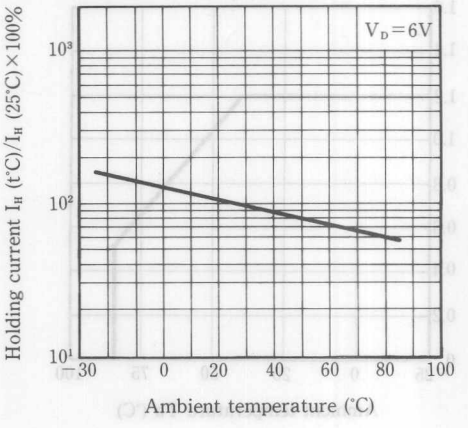


Fig. 9 On-state Current vs. On-state Voltage

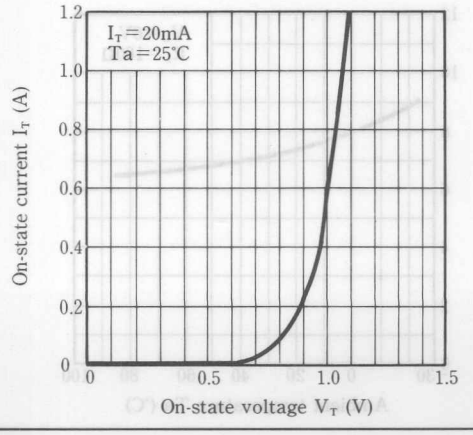


Fig. 10 Turn-on Time vs. Forward Current (S101D01)

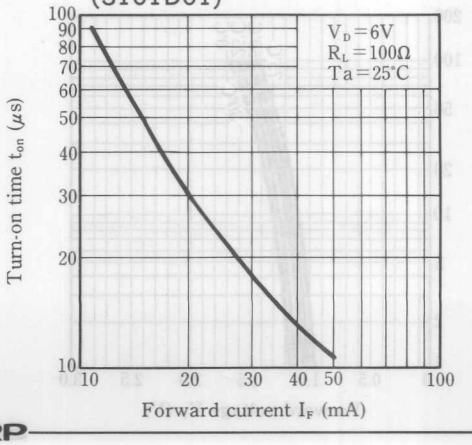


Fig. 11 Turn-on Time vs. Forward Current (S101D02, S201D02)

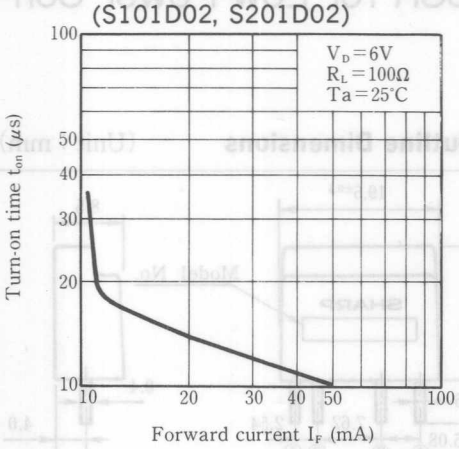
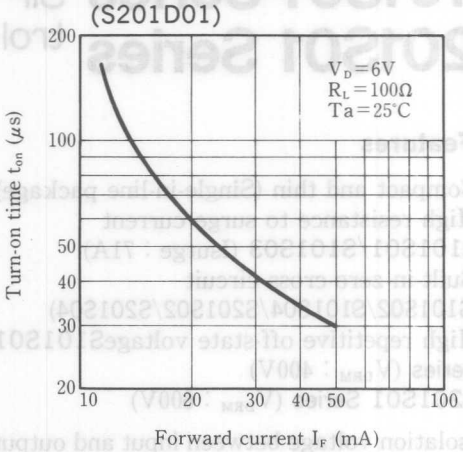
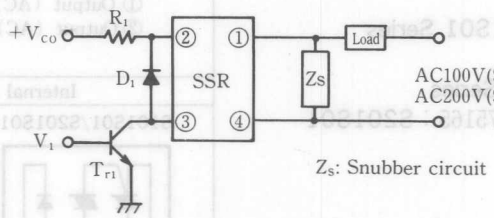
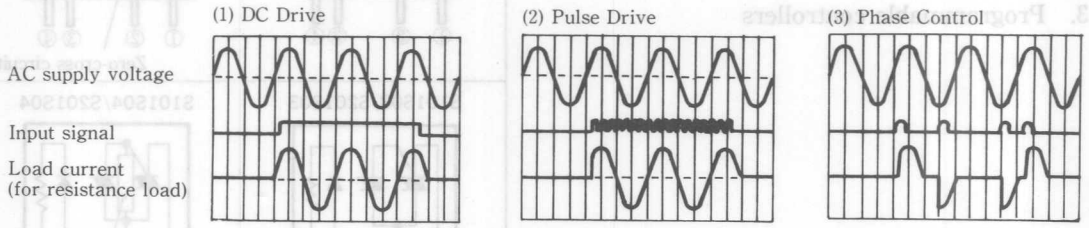


Fig. 12 Turn-on Time vs. Forward Current (S201D01)



■ Basic Operation Circuit





Note 1) If a large amount of surge is loaded onto V_{CC} or the driver circuit, add a diode D_1 between terminals 2 and 3 to prevent reverse bias from being applied to the infrared LED.

2) Be sure to install a surge absorption circuit.
An appropriate circuit must be chosen according to the load (for CR, choose its constant). This must be carefully done especially for an inductive load.

3) For phase control, adjust such that the load current immediately after the input signal is applied will be more than 50mA.

(Precautions for Use)

1) All pins must be soldered since they are also used as heat sinks. (heat radiation fins.) In designing, take into the heat radiation from the mounted SSR.
2) For higher radiating efficiency that allows wider thermal margin, secure a wider round pattern for Pin 15 when designing mounting pattern. The rounded part of Pin 15 (gate) must be as small as possible. Pulling the gate pattern around increases the chance of being affected by external noise.

8

S101S01 Series S201S01 Series SIP Type SSR for Low Power Control

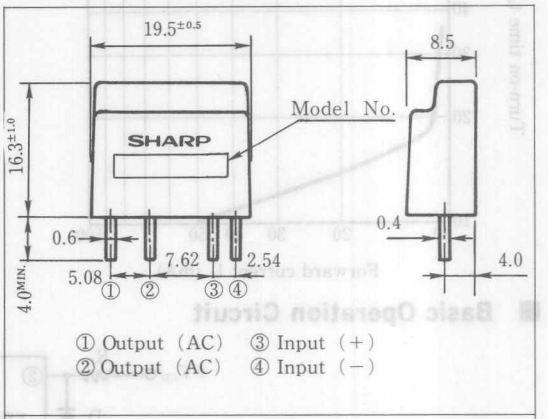
■ Features

1. Compact and thin (Single-in-line package)
2. High resistance to surge current
   S101S01/S101S03 (Isurge : 71A)
3. Built-in zero-cross circuit
   (S101S02/S101S04/S201S02/S201S04)
4. High repetitive off-state voltage S101S01 Series (V_{DRM} : 400V)
   S201S01 Series (V_{DRM} : 600V)
5. Isolation voltage between input and output (V_{iso} : 4,000Vrms)
6. UL recognized,
   file No. E94758 : S101S01 Series
   CSA approved
   No. 63705 : S101S01 Series
   TÜV approved No. R75165 : S201S01

■ Applications

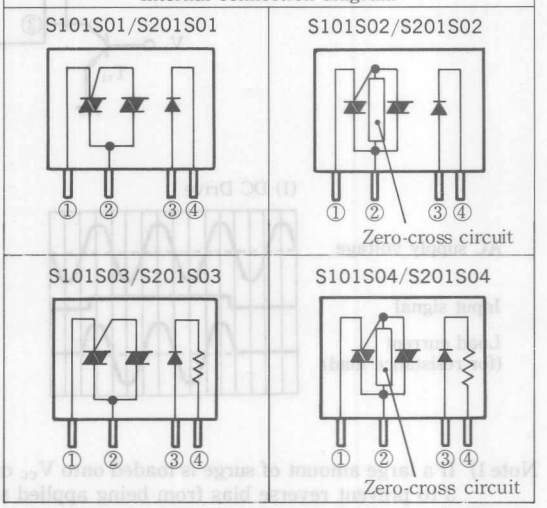
1. TVs
2. Air conditioners
3. Programmable controllers

■ Outline Dimensions (Unit : mm)



① Output (AC) ③ Input (+)
② Output (AC) ④ Input (−)

Internal connection diagram

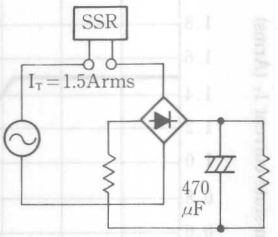


■ Absolute Maximum Ratings

(Ta=25°C)

Parameter			Symbol	Rating	Unit
Input	Forward current	S101S01/S101S02 S201S01/S201S02	I_F	50	mA
	Input signal voltage	S101S03/S101S04 S201S03/S201S04	V_{IN}	6	V
	Reverse voltage		V_R	6	V
Output	RMS on-state current		I_T	1.5	Arms
	*1Surge current	S101S01/S101S03	Isurge	71	A
	*2Peak one cycle surge current	S101S02/S101S04 S201S01 Series		30	A
	Repetitive peak off-state voltage	S101S01 Series	V_{DRM}	400	V
		S201S01 Series		600	V
	Non-repetitive peak off-state voltage	S101S01 Series	V_{DSM}	420	V
		S201S01 Series		615	V
	Critical rate of rise of on-state current		dI_T/dt	40	A/μs
*3Isolation voltage			V_{iso}	4,000	Vrms
Operating temperature			T_{opr}	−25～+100	°C
Storage temperature			T_{stg}	−30～+125	°C
*4Soldering temperature			T_{sol}	260	°C

Basic Circuit for Surge Current



Determined by the peak value of surge current obtained when the output is on at AC 100V peak value (100x$\sqrt{2}$).

*1 Determined by above circuit
*2 60Hz, sine wave
*3 RH=40～60%, AC 60Hz for 1 minute
*4 For 10 seconds

■ Electrical Characteristics

(Ta=25°C)

Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Forward voltage	S101S01/S101S02 S201S01/S201S02	V_F	I_F=20mA	—	1.2	1.4	V
	Reverse current	S101S01/S101S02 S201S01/S201S02	I_R	V_R=3V	—	—	10^{-4}	A
	Input signal voltage	S101S03/S101S04 S201S03/S201S04	V_{IN}	Ta=T_{opr}	4	5	6	V
	Input resistance	S101S03/S101S04 S201S03/S201S04	R_{IN}		117	130	143	Ω
	Pick-up voltage	S101S03/S101S04 S201S03/S201S04	Vpu	V_D=6V, R_M=30Ω	—	—	4	V
	Drop-out voltage	S101S03/S101S04 S201S03/S201S04	Vdo	V_D=200V	1	—	—	V
Output	Repetitive peak off-state current		I_{DRM}	V_D=V_{DRM}	—	—	10^{-4}	A
	On-state voltage		V_T	I_T=1.5Arms, R load	—	—	1.5	Vrms
	Holding current		I_H		—	—	50	mA
	Critical rate of rise of off-state voltage		dv/dt	V_D=2/3V_{DRM}	30	—	—	V/μs
	Commutation critical rate of rise of off-state voltage		(dv/dt)c	T_j=125°C, V_D=400V dI_T/dt=−1.0A/ms	4	—	—	V/μs
	Zero-cross voltage		V_{OX}	I_F=15mA	—	—	35	V
Transfer characteristics	Minimum trigger current	S101S01/S101S02 S201S01/S201S02	I_{FT}	V_D=6V, R_L=30Ω	—	—	15	mA
	Isolation resistance		R_{ISO}	DC500V, RH=40～60%	10^{10}	—	—	Ω
	Turn-on tine	S101S01/S101S03 S201S01/S201S03	t_{on}	AC50Hz	—	—	1	ms
		S101S02/S101S04 S201S02/S201S04			—	—	10	
	Turn-off time		t_{off}	AC50Hz	—	—	10	ms
	Thermal resistance (between junction and ambience)		Rth(j−a)		—	60	—	°C/W

8

Fig. 1 RMS On-state Current vs. Ambient Temperature

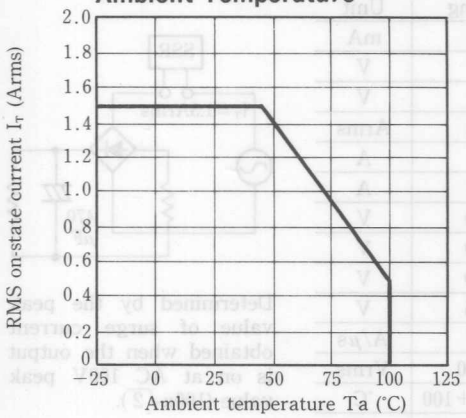


Fig. 2 Forward Current vs. Ambient Temperature

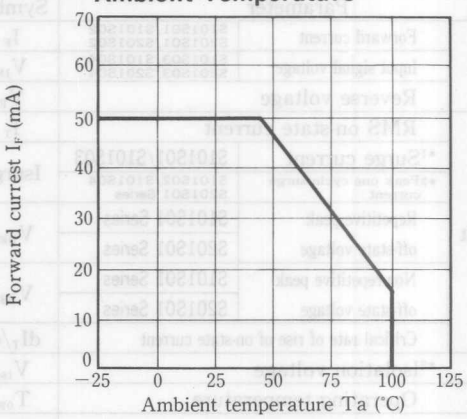


Fig. 3 Forward Current vs. Forward Voltage (S101S01/S101S02/S201S01/S201S02)

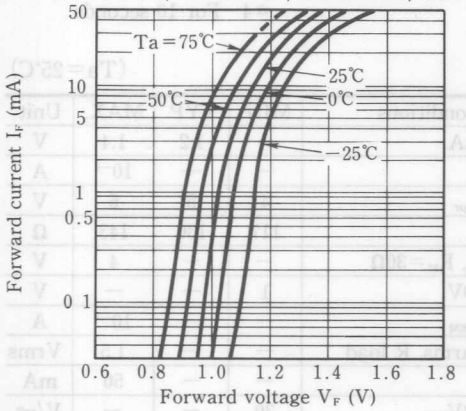


Fig. 4 Minimum Trigger Current vs. Ambient Temperature (S101S01/S101S02/S201S01/S201S02)

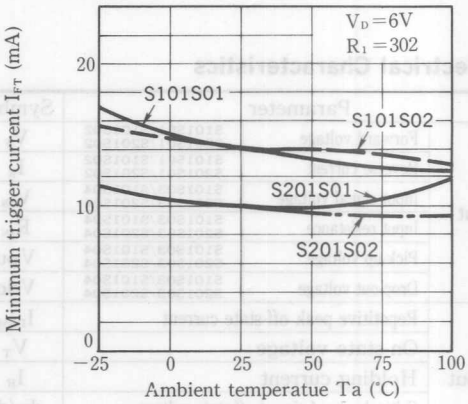


Fig. 5 Pick-up Voltage vs. Ambient Temperature

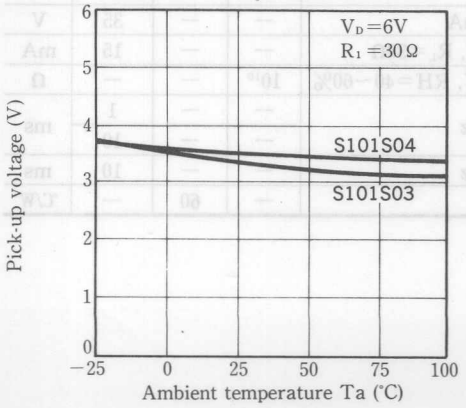


Fig. 6 Pick-up Voltage vs. Ambient Temperature

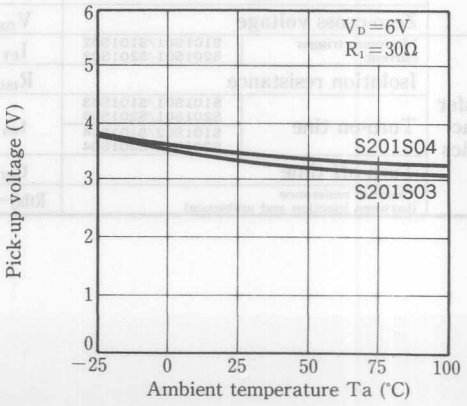


Fig. 7 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature (S101S01 Series)

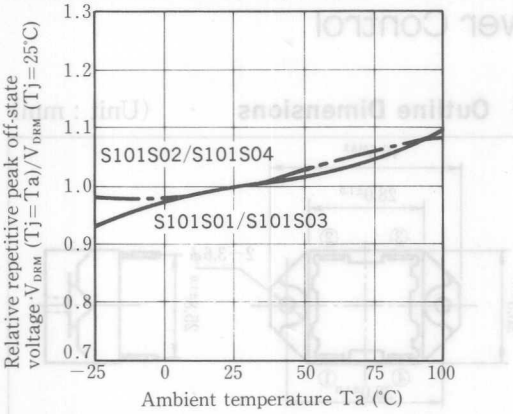


Fig. 8 Relative Repetitive Peak Off-state Voltage vs. Ambient Temperature (S201S01 Series)

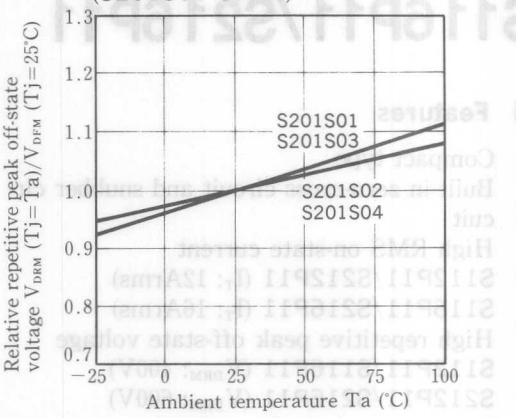


Fig. 9 Repetitive Peak Off-state Current vs. Ambient Temperature (S101S01 Series)

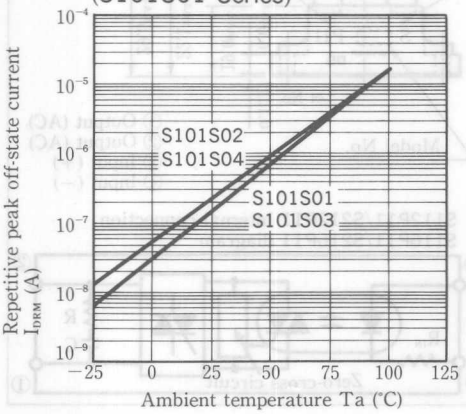
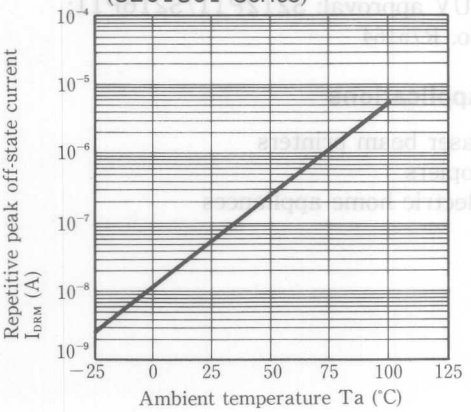


Fig. 10 Repetitive Peak Off-state Current vs. Ambient Temperature (S201S01 Series)



8

S112P11/S212P11 S116P11/S216P11

Built-in Zero-Cross Circuit, Compact SSR for Medium Power Control

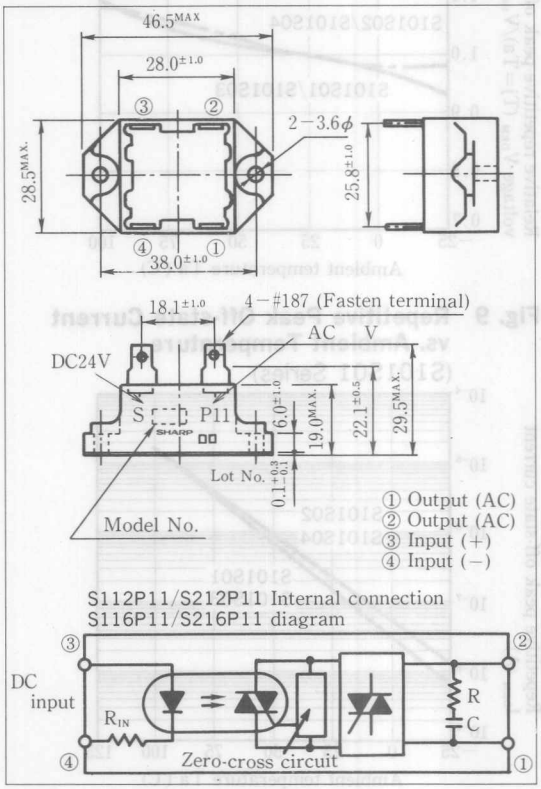
■ Features

1. Compact type
2. Built-in zero-cross circuit and snubber circuit
3. High RMS on-state current
   S112P11/S212P11 (I_T: 12Arms)
   S116P11/S216P11 (I_T: 16Arms)
4. High repetitive peak off-state voltage
   S112P11/S116P11 (V_{DRM}: 400V)
   S212P11/S216P11 (V_{DRM}: 600V)
5. Input-output isolation voltage
   S112P11/S116P11 (V_{iso}: 2,500Vrms)
   S212P11/S216P11 (V_{iso}: 4,000Vrms)
6. TÜV approval: S212P11/S216P11: No. R75164

■ Applications

1. Laser beam printers
2. Copiers
3. Electric home appliances

■ Outline Dimensions (Unit : mm)



S112P11/S212P11 Internal connection
S116P11/S216P11 diagram

■ Absolute Maximum Rating (Ta=Tc=25°C)

Parameter			Symbol	Rating	Unit
Input	Input signal voltage		V_{IN}	26	V
	Reverse voltage		V_R	6	V
Output	RMS on-state Current	S112P11 S212P11	I_T	12	Arms
		S116P11 S216P11		16	
	*1Peak one cycle surge current	S112P11 S212P11	I_{TSM}	120	A
		S116P11 S216P11		160	
	Repetitive peak off-state voltate	S112P11 S116P11	V_{DRM}	400	V
		S212P11 S216P11		600	
	Load supply voltage	S112P11 S116P11	V_{OUT}	135	Vrms
		S212P11 S216P11		250	
*2Isolation voltage		S112P11 S116P11	V_{iso}	2,500	Vrms
		S212P11 S216P11		4,000	
Operating temperature			T_{opr}	−20～+80	°C
Storage temperature			T_{stg}	−30～+100	°C
*3Soldering temperature			T_{sol}	260	°C

*1 60Hz, sine wave, T_j=25°C start

*2 RH=40～60%, AC 60Hz for 1 minute
Apply voltages between input, output and the base of SSR dielectric withstand voltage tester with zero-cross circuit.

*3 For 10 seconds

■ Electrical Characteristics

(Ta=T_C=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Input resistance	R_{IN}		—	1.1	—	kΩ
	Pick-up voltage	V_{pu}	V_D=6V, R_L=30Ω	—	—	18.0	V
	Drop-out voltage	V_{do}	V_D=6V, R_L=30Ω	1.0	—	—	V
Output	On-state voltage	V_T	S112P11/S212P11: I_T=12Arms, S116P11/S216P11: I_T=16Arms, I_T=2Arms, V_{in}=24V, Load resistance	—	—	1.5	Vrms
	Minimum operating current	I_{op}	S112P11, S116P11: V_{out}=120Vrms S212P11, S216P11: V_{out}=240Vrms	—	—	100	mArms
	Open circuit leak current	I_{leak}	S112P11, S116P11: V_{out}=120Vrms S212P11, S216P11: V_{out}=240Vrms	—	—	S112P11 S116P11: 10 S212P11 S216P11: 15	mArms
	Zero-cross voltage	V_{ox}	V_{in}=24V	—	—	35	V
	Critical rate of rise of off-state voltage	dv/dt	V_D=2/3V_{DRM}	30	—	—	V/μs
Transfer characteristics	Isolation resistance	R_{ISO}	DC500V, RH=40~60%	10^{10}	—	—	Ω
	Turn-on time	t_{on}	AC60Hz	—	—	9.3	ms
	Turn- off time	t_{off}	AC60Hz	—	—	9.3	ms
Thermal resistance (Between junction and case)	S112P11 S116P11	R_{th}(j~c)		—	—	2.4	°C/W
	S212P11 S216P11			—	—	3.0	

■ Recommended Operating Conditions

Parameter			Symbol	MIN.	MAX.	Unit
Input	Input signal voltage		V_{IN}	22.5	25.5	V
Output	Load supply voltage	S112P11 S116P11	V_{out}	80	120	Vrms
		S212P11 S216P11		80	240	
	Frequency		f	45	65	Hz
	Load power factor		COSφ	50	100	%

Fig. 1 RMS On-state Current vs. Case Temperature

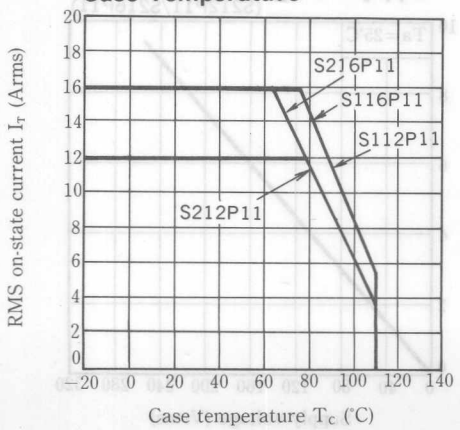
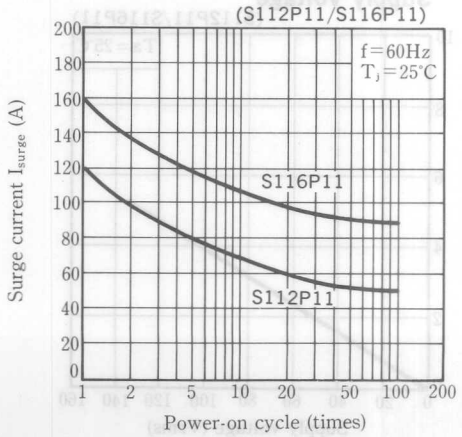


Fig. 2 Surge Current vs. Power-on Cycle



8

Fig. 3 Surge Current vs. Power-on Cycle

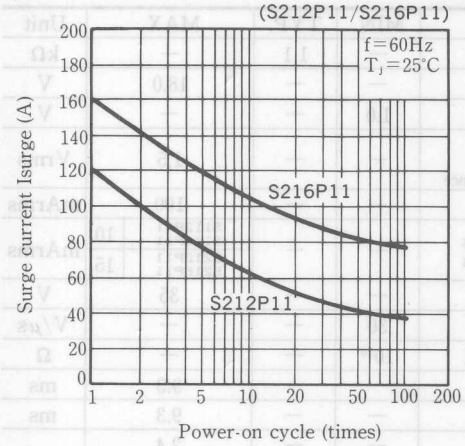


Fig. 4 Maximum On-state Power Dissipation vs. RMS On-state Current

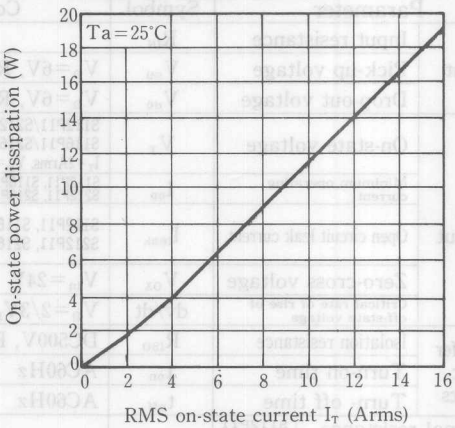


Fig. 5 Relative Pick-up, Drop-out Voltage vs. Ambient Temperature

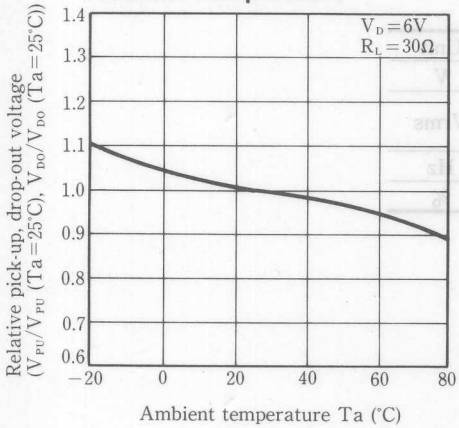


Fig. 6 Input Characteristics

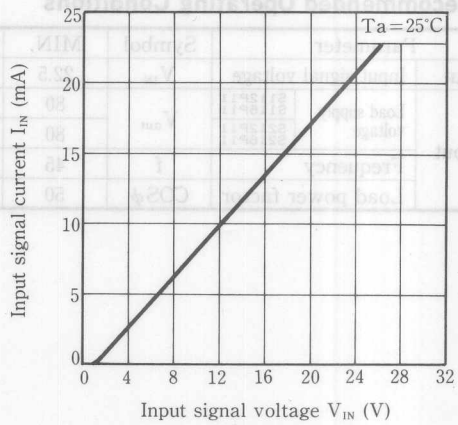


Fig. 7 Open Circuit Leak Current vs. Supply Voltage

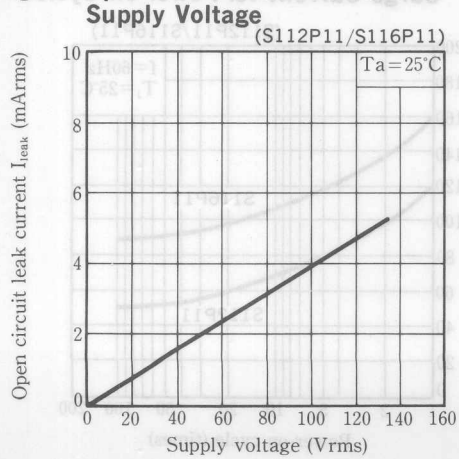
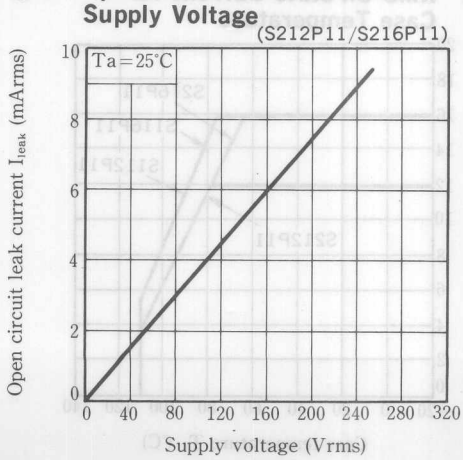


Fig. 8 Open Circuit Leak Current vs. Supply Voltage



S116P21/S216P21 2-channel Type SSR for Medium Power Control

■ Features

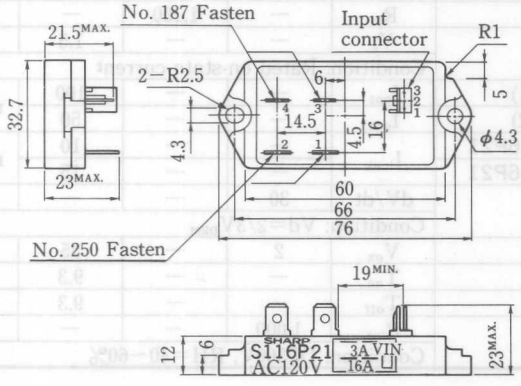
1. 2-channel high density type
2. Built-in zero-cross circuit & snubber circuit
3. With heat sink
4. High repetitive peak off-state voltage
   S116P21 V_{DRM}: 400V
   S216P21 V_{DRM}: 600V
5. Isolation voltage
   S116P21 V_{iso}: 2,000Vrms
   S216P21 V_{iso}: 4,000Vrms

■ Applications

1. For power control of general electronic appliances, such as copiers

■ Outline Dimensions

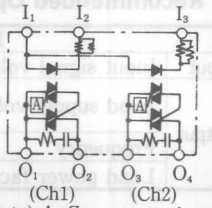
(Unit: mm)



(Note 1) The housing that matches the input connector is the AMP-made 171822-3 or its equivalents.
(Note 2) 2 digit number marked according to DIN standard

	No.	Terminal name
Input	1	I1
	2	I2
	3	I3
Output	1	O1
	2	O2
	3	O3
	4	O4

Internal connection diagram



Note) A: Zero-cross circuit

8

■ Absolute Maximum Ratings

(Ta=T_c=25°C)

Parameter			Symbol	Rating	Unit
Input	Forward voltage		V_{in}	26	V
	Reverse voltage		V_R	6	V
Output	*1RMS on-state current	(Ch1)	I_{t1}	16	Arms
		(Ch2)	I_{t2}	3	Arms
	*2Peak one cycle surge current	(Ch1)	I_{sg1}	160	A
		(Ch2)	I_{sg2}	30	A
	Repetitive peak off-state voltage	S116P21	V_{DRM}	400	V
		S216P21		600	V
Isolation voltage	S116P21	*3Between input and output	V_{iso1}	2,000	Vrms
	S216P21			4,000	
	S116P21	*3Between I/O and heat sink	V_{iso2}	2,000	
	S216P21				
Operating temperature			T_{opr}	−20~80	°C
Storage temperature			T_{stg}	−30~100	°C
*4Soldering temperature			T_{sol}	260	°C
Load supply voltage		S116P21	V_{OUT}	135	Vrms
		S216P21		250	
Case temperature			T_C	80 Max.	°C

*1 Derating factor is shown in Fig. 1.
*2 AC 60Hz, sine wave
*3 Isolation voltage shall be measured by the dielectric withstand tester with a zero-cross circuit between input, output ande heat sink.
*4 For 10 seconds

■ Electrical Characteristics

(Unless otherwise specified, V_{in}=24V, V_{out}=120V(S116P21)/240V(S216P21), f=60Hz, Load power factor=100%

(Ta=T_c=25°C)

Parameter			Symbol	MIN.	TYP.	MAX.	Unit
Input	Pick-up voltage		V_{pu}	—	—	18.0	V
	Drop-out voltage		V_{do}	1.0	—	—	V
	Input impedance		R_{in}	—	1,100	—	Ω
Output	On-state voltage		V_t	—	—	1.5	Vrms
			Condition: Rated on-state current				
	Minimum Operating current	(Ch1)	I_{op1}	—	—	100	mArms
		(Ch2)	I_{op2}	—	—	50	
	Open circuit leak current	S116P21	I_{leak}	—	—	10	mArms
		S216P21		—	—	15	
	Critical rate of rise of off-state voltage		dV/dt	30	—	—	V/μs
			Condition: Vd=2/3V_{DRM}				
	Zero-cross voltage		V_{ox}	2	—	35	V
Transfer characteristics	Turn-on time		T_{on}	—	—	9.3	ms
	Turn-off time		T_{off}	—	—	9.3	ms
	Isolation resistance		R_{iso}	1,000	—	—	MΩ
			Condition: DC500V, RH=40~60%				

■ Recommended Operating Conditions

Parameter			Symbol	Conditions	Unit
Input	Input signal voltage		V_{in}	22.5~25.5	V
Output	Load supply voltage	S116P21	V_{out}	80~120	Vrms
		S216P21		80~240	
	Frequency		f	45~65	Hz
	Load power factor		cosφ	50~100	%

Fig. 1 RMS On-state Current vs. Case Temperature

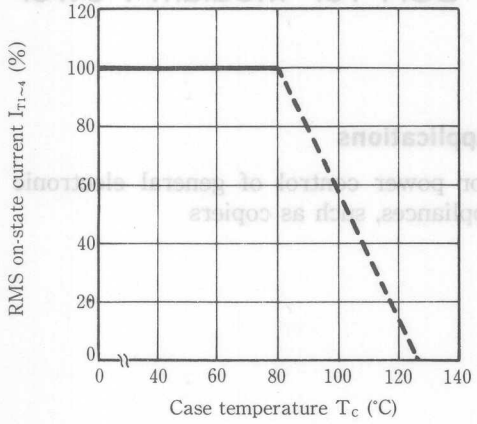


Fig. 2 Surge Current rs. Power-on Cycle

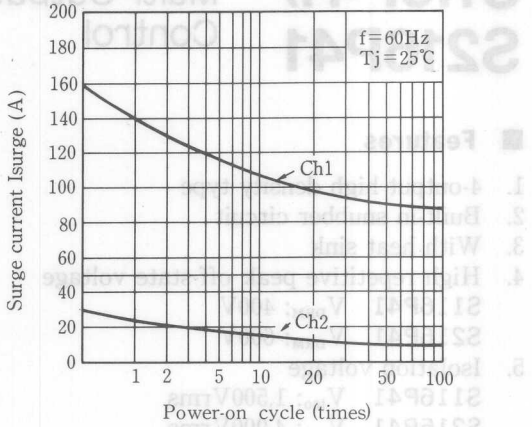


Fig. 3 Maximum On-state Power Dissipation vs. RMS On-state Current

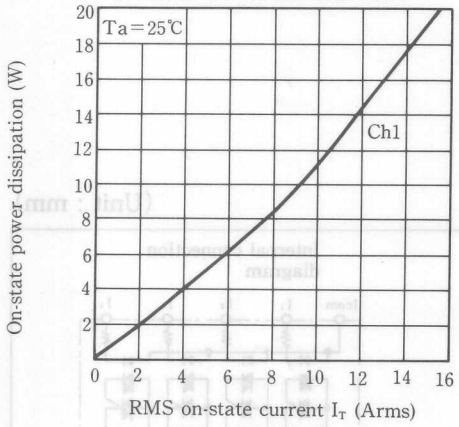


Fig. 4 Maximum On-state Power Dissipation vs. RMS On-state Current

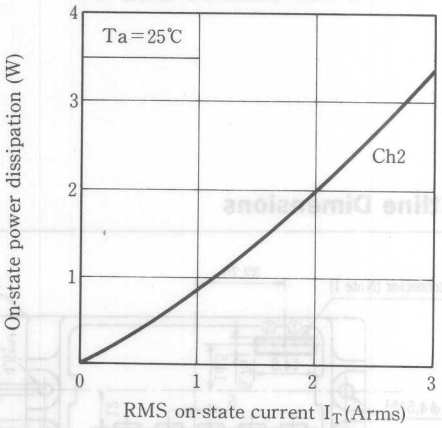
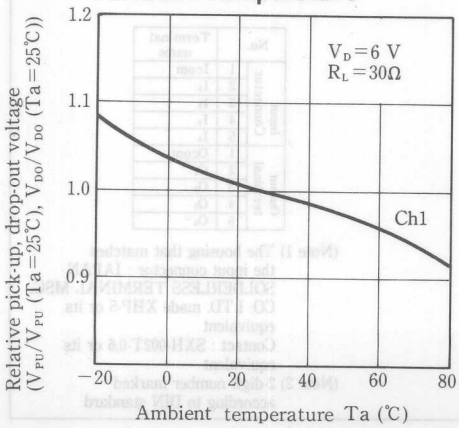


Fig. 5 Relative Pick-up, Drop-out Voltage vs. Ambient Temperature



8

S116P41/ S216P41 Multi-Output Type SSR for Medium Power Control

■ Features

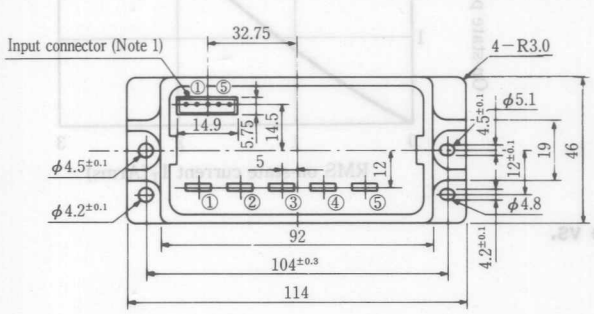
1. 4-output high density type
2. Built-in snubber circuit
3. With heat sink
4. High repetitive peak off-state voltage
   S116P41 V_{DRM}: 400V
   S216P41 V_{DRM}: 600V
5. Isolation voltage
   S116P41 V_{iso}: 1,500Vrms
   S216P41 V_{iso}: 4,000Vrms

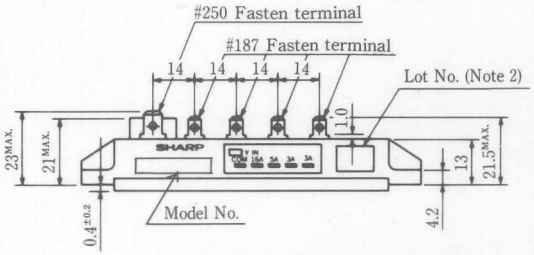
■ Applications

1. For power control of general electronic appliances, such as copiers

■ Outline Dimensions

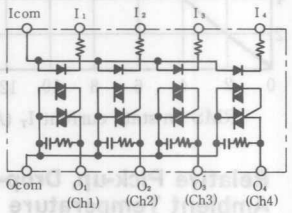
(Unit : mm)





Unspecified tolerance shall be ±0.5mm.

Internal connection diagram



	No.	Terminal name
Input Connector	1	Icom
	2	I_1
	3	I_2
	4	I_3
	5	I_4
Output terminal	1	Ocom
	2	O_1
	3	O_2
	4	O_3
	5	O_4

(Note 1) The housing that matches the input connector : JAPAN SOLDERLESS TERMINAL MSG. CO. LTD. made XHP-5 or its equivalent
Contact : SXH-002T-0.6 or its equivalent
(Note 2) 2-digit number marked according to DIN standard

■ Absolute Maximum Ratings

(Ta=T_c=25°C)

Parameter			Symbol	Rating	Unit
Input	Forward voltage		V_{in}	6.0	V
	Reverse voltage		V_R	6.0	V
Output	RMS on-state current	(Ch1)	I_{t1}	16.0	Arms
		(Ch2 of S116P41)	I_t	5.0	Arms
		(Ch2~4)	I_{t2}	3.0	Arms
	*1Peak one cycle surge current	(Ch1)	I_{sg1}	160	A
		(Ch2 of S116P41)		80	A
		(Ch2~4)	I_{sg2}	30	A
	Repetitive peak off-state voltage	S116P41	V_{DRM}	400	V
		S216P41		600	V
	*2Isolation voltage	S116P41	V_{iso}	1,500	Vrms
		S216P41		4,000*4	
	Operating temperature		T_{opr}	−20~80	°C
	Storage temperature		T_{stg}	−30~100	°C
	*3Soldering temperature		T_{sol}	260	°C
	Load supply voltage	S116P41	V_{out}	135	Vrms
		S216P41		250	Vrms
	Case temperature		T_c	80 Max.	°C

*1 AC 60Hz, sine wave
*2 Isolation voltage shall be measured by the dielectric withstand tester with a zero-cross circuit between input, output and heat sink.
*3 For 10 seconds
*4 Between input, output and fin: 2,000Vrms

■ Electrical Characteristics

(Ta=T_c=25°C)

Parameter			Symbol	MIN.	TYP.	MAX.	Unit
Input	Pick-up voltage		V_{pu}	—	—	4.0	V
	Drop-out voltage		V_{do}	1.0	—	—	V
	Input impedance		R_{in}	110	130	150	Ω
Output	On-state voltage		V_t	—	—	1.5	Vrms
			Condition: Rated on-state current				
	*5Minimum operating current	(Ch1)	I_{op1}	—	—	100	mArms
		(Ch2~4)	I_{op2}	—	—	50	mArms
	*6Open circuit leak current	(Ch1)	I_{leak}	—	—	15	mArms
		(Ch2~4)		—	—	3	
	Critical rate of rise of off-state voltage		dV/dt	30	100	—	V/μs
			Condition: Vd=2/3V_{drm}				
Transfer characteristics	Turn-on time		T_{on}	—	—	1	ms
	Turn-off time		T_{off}	—	—	13.5	ms
	Isolation resistance		R_{iso}	10^9	—	—	Ω
			Condition: DC500V, RH=40~60%				

*5 Condition: At applying rated voltage in the R load
*6 Condition: At applying AC120V (S116P41)
At applying AC240V (S216P41)

■ Recommended Operating Conditions

Parameter			Symbol	Conditions	Unit
Input	Input signal voltage		V_{in}	4.5~5.5	V
Output	Load supply voltage	S116P41	V_{out}	60~140	Vrms
		S216P41		80~240	
	Frequency		f	40~70	Hz
	Load power factor		cosφ	25~100	%

8

Fig. 1 RMS On-state Current vs. Case Temperature

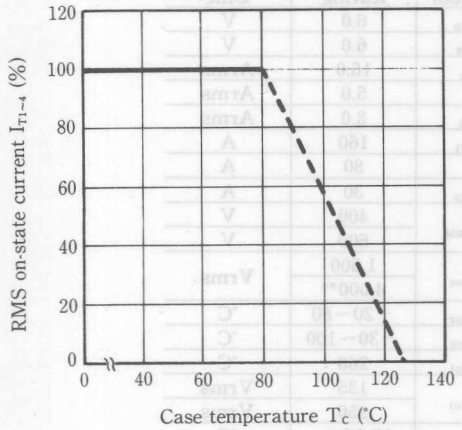


Fig. 2 Surge Current vs. Power-on Cycle

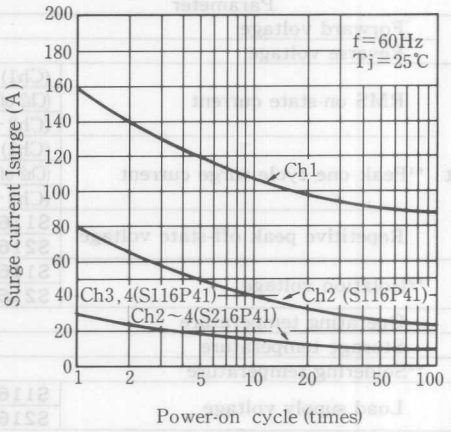


Fig. 3 Maximum On-state Power Dissipation vs. RMS On-state Current

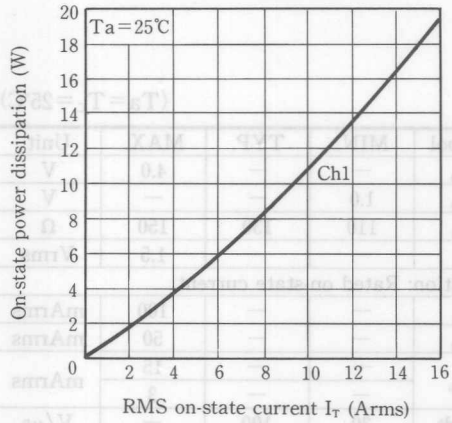


Fig. 4 Maximum On-state Power Dissipation vs. RMS On-state Current

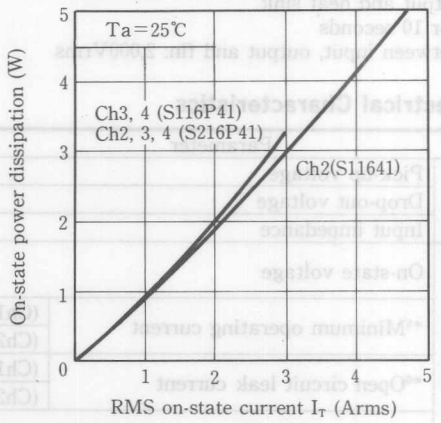


Fig. 5 Relative Pick-up, Drop-out Voltage vs. Ambient Temperature

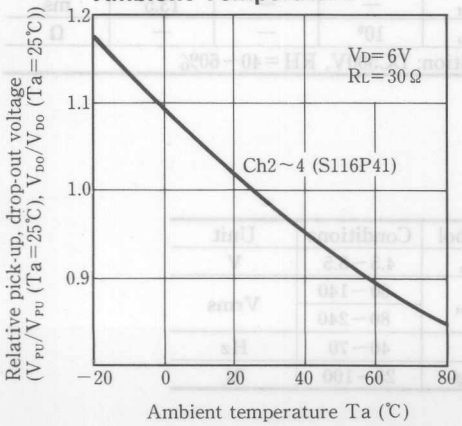
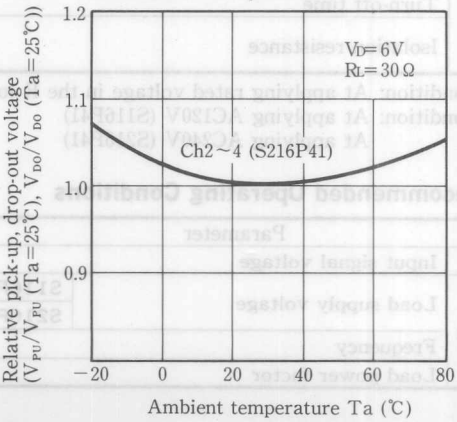


Fig. 6 Relative Pick-up, Drop-out Voltage vs. Ambient Temperature



S116P42/ S216P42 Multi-Output Type SSR for Medium Power Control

■ Features

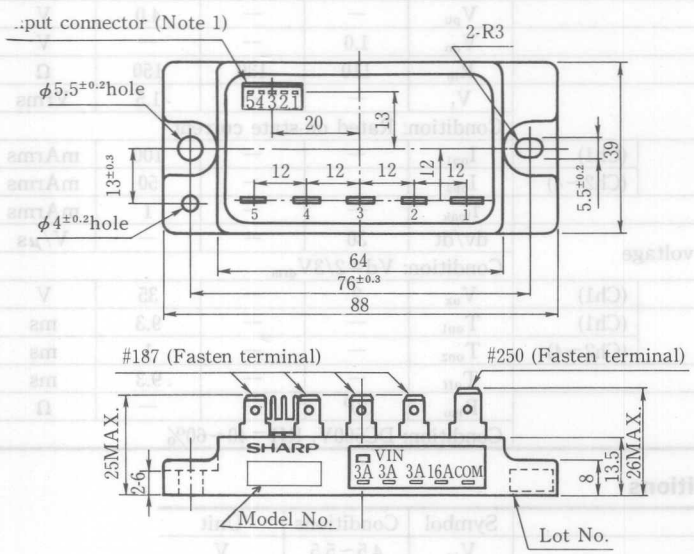
1. 4-output high density type
2. Built-in zero-cross circuit (Channel 1 only)
3. With heat sink
4. High repetitive peak off-state voltage
   S116P42 V_{DRM}: 400V
   S216P42 V_{DRM}: 600V
5. Isolation voltage
   S116P42 V_{iso}: 2,000Vrms
   S216P42 V_{iso}: 4,000Vrms

■ Applications

1. For power control of general electronic appliances, such as copiers

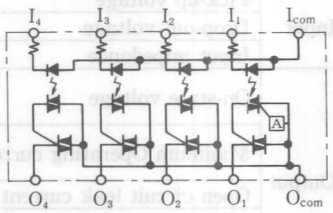
■ Outline Dimensions

(Unit : mm)



Unspecified tolerance shall be ±0.5mm.

Internal connection diagram



Note) A: Zero-cross circuit

	No.	Terminal name
Input pin	1	I_{com}
	2	I_1
	3	I_2
	4	I_3
	5	I_4
Output pin	1	O_{com}
	2	O_1
	3	O_2
	4	O_3
	5	O_4

Note 1)
The housing that matches the input connector is the JAPAN SOLDERLESS MSG. CO., LTD. made H5P-SHF-AA.

8

■ Absolute Maximum Ratings

($Ta = T_c = 25°C$)

Parameter				Symbol	Rating	Unit
Input	Forward voltage			V_{in}	6.0	V
	Reverse voltage			V_r	6.0	V
Output	*1RMS on-state current		(Ch1)	I_{t1}	16.0	Arms
			(Ch2~4)	I_{t2}	3.0	Arms
	*2Peak one cycle surge current		(Ch1)	I_{sg1}	160	A
			(Ch2~4)	I_{sg2}	30	A
	Repetitive peak off-state voltage		S116P42	V_{DRM}	400	V
			S216P42		600	V
*3Isolation voltage	S116P42			V_{iso}	2,000	Vrms
	S216P42	Between input and output		V_{iso1}	4,000	Vrms
		Between input, output and heat sink		V_{iso2}	2,000	Vrms
Operating temperature				T_{opr}	−20~80	°C
Storage temperature				T_{stg}	−30~100	°C
*4Soldering temperature				T_{sol}	260	°C
Load supply voltage			S116P42	V_{out}	135	Vrms
			S216P42		250	Vrms
Case temperature				T_c	80 Max.	°C

*1 Derating factor is shown in Fig. 1.
*2 AC 60Hz, sine wave
*3 Isolation voltage shall be measured by the dielectric withstand tester with a zero-cross circuit between input, output and heat sink.
*4 For 10 seconds

■ Electrical Characteristics

(Unless otherwise specified, V_{in}=5V, V_{out}=120V for S116P42/V_{out}=240V for S216P42, ($Ta = T_c = 25°C$) f=60Hz, Load power factor=100%)

Parameter			Symbol	MIN.	TYP.	MAX.	Unit
Input	Pick-up voltage		V_{pu}	—	—	4.0	V
	Drop-out voltage		V_{do}	1.0	—	—	V
	Input impedance		R_{in}	110	130	150	Ω
Output	On-state voltage		V_t	—	—	1.5	Vrms
			Condition: Rated on-state current				
	Minimum Operating current	(Ch1)	I_{op1}	—	—	100	mArms
		(Ch2~4)	I_{op2}	—	—	50	mArms
	Open circuit leak current		I_{leak}	—	—	1	mArms
	Critical rate of rise of off-state voltage		dv/dt	30	—	—	V/μs
			Condition: Vd=2/3V_{drm}				
	Zero-cross voltage	(Ch1)	V_{ox}	2	—	35	V
Transfer characteristics	Turn-on time	(Ch1)	T_{on1}	—	—	9.3	ms
		(Ch2~4)	T_{on2}	—	—	1	ms
	Turn-off time		T_{off}	—	—	9.3	ms
	Isolation resistance		R_{iso}	10^9	—	—	Ω
			Condition: DC500V, RH=40~60%				

■ Recommended Operating Conditions

Parameter			Symbol	Conditions	Unit
Input	Input signal voltage		V_{in}	4.5~5.5	V
Output	Load supply voltage	S116P42	V_{out}	80~120	Vrms
		S116P42		80~240	
	Frequency		f	45~65	Hz
	Load power factor		cosφ	50~100	%

Fig. 1 RMS On-state Current vs. Case Temperature

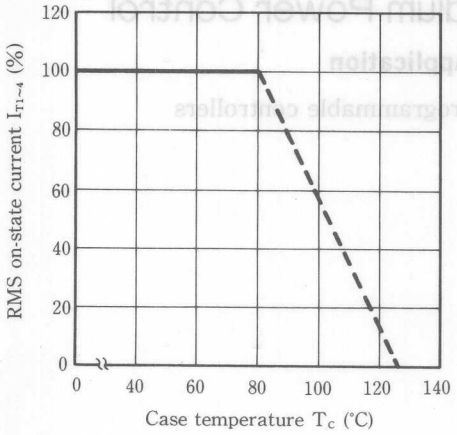


Fig. 2 Surge Current vs. Power-on Cycle

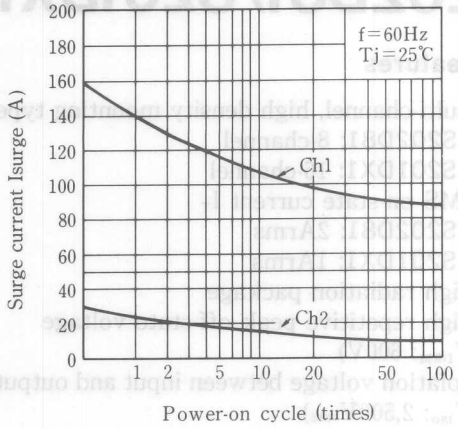


Fig. 3 Maximum On-state Power Dissipation vs. RMS On-state Current

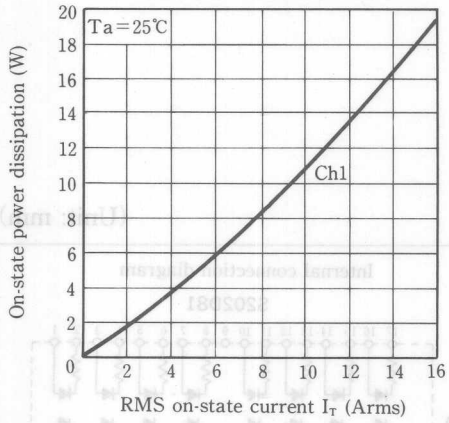


Fig. 4 Maximum On-state Power Dissipation vs. RMS On-state Current

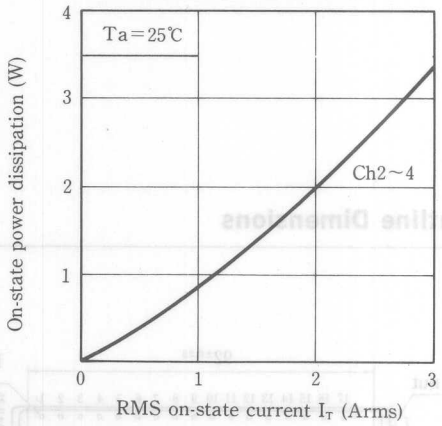


Fig. 5 Relative Pick-up, Drop-out Voltage vs. Ambient Temperature

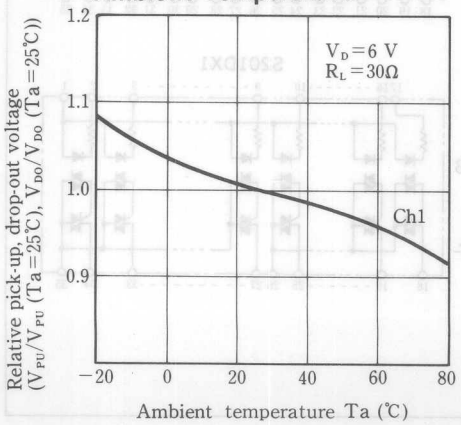
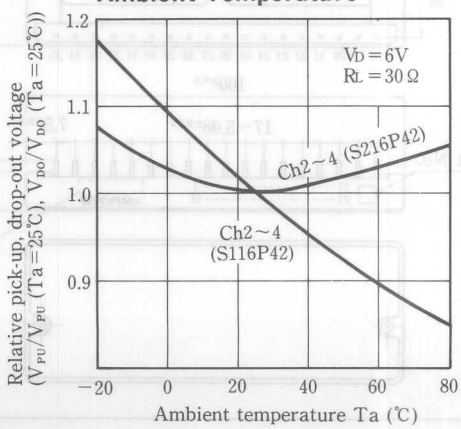


Fig. 6 Relative Pick-up, Drop-out Voltage vs. Ambient Temperature



8

S202D81/S201DX1

Multi-channel Type SSR for Medium Power Control

■ Features

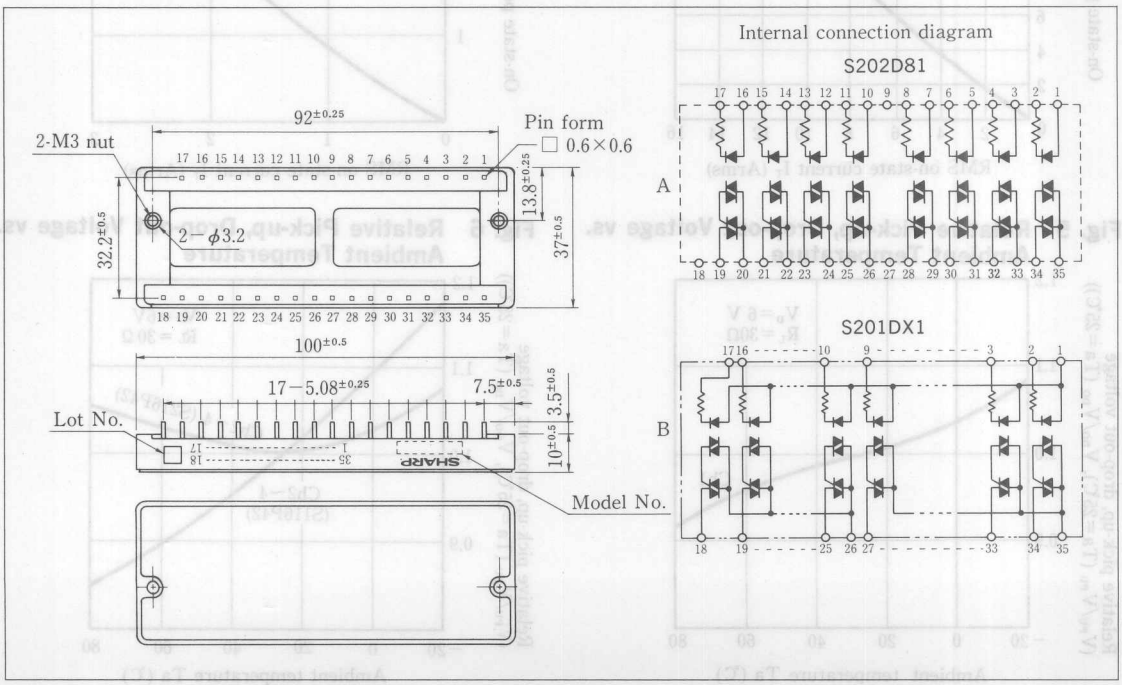
1. Multi-channel, high density mounting type
   S202D81: 8-channel
   S201DX1: 16-channel
2. RMS on-state current I_T
   S202D81: 2Arms
   S201DX1: 1Arms
3. High radiation package
4. High repetitive peak off-state voltage (V_{DRM}: 600V)
5. Isolation voltage between input and output (V_{iso}: 2,500V_{rms})

■ Application

1. Programmable controllers

■ Outline Dimensions

(Unit: mm)



■ Absolute Maximum Ratings

(Ta=20°C~+85°C)

Parameter		Symbol	Rating		Unit
			S202D81	S201DX1	
Input	Input signal voltage	V_{IN}	6	6	V
	Reverse voltage	V_R	6	6	V
Output	RMS on-state current	I_{T1}	2	1	Arms
	Total RMS on-state current (Ta=85°C)	I_{T2}	4.5	4.5	Arms
	Total RMS on-state current (including ideal heat sink)	I_{T3}	16	16	Arms
	Repetitive peak off-state voltage	V_{DRM}	600	600	V
	*1Peak one cycle surge current	I_{surDe1}	60	60	A
	*1100ms surge current	I_{surDe2}	40	40	A
	Max. load power supply frequency	f_{max}	65	65	Hz
	Min. load power supply frequency	f_{min}	45	45	Hz
	Load power supply voltage	V_{out}	265	265	Vrms
	Isolation voltage	V_{iso}	2,500	2,500	Vrms
	Operating temperature	T_{opr}	−30~+85	−30~+85	°C
	Storage temperature	T_{stg}	−30~+100	−30~+100	°C
	*3Soldering temperature	T_{sol}	260	260	°C

*1 60Hz sine wave, Ta=25°C, Tj=25°C start

*2 Apply voltage between input, output and heat sink, between one output channel and another (S202D81), between Pin 18 and 26, Pin 27 and Pin 35 (S201DX1) using dielectric withstand tester with zero-cross circuit, AC for 1 minute.

*3 For 10 seconds

■ Electrical Characteristics

(Ta=−20~+85°C)

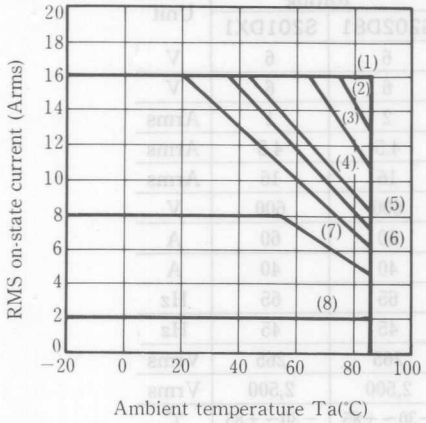
Parameter			Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input	Pick-up voltage		V_{pu}		—	—	3.0	V
	Drop-out voltage		V_{do}		1.0	—	—	V
	Input resistance		R_{IN}		120	130	140	Ω
Output	On-state voltage		V_T	Rated on-state current, Ta=25°C	—	—	1.2	Vrms
	Minimum operating current		I_{op}	Rated on-state voltage Ta=25°C	—	—	30	mArms
	Open circuit leak current		I_{leak}	AC200V	—	—	0.5	mArms
	Critical rate of rise of off-state voltage		dv/dt	Ta=85°C, V_D=2/3V_{DRM}	50	—	—	V/μs
	Commutation critical rate of rise of off-state voltage		(dv/dt)c	Ta=85°C, V_D=2/3V_{DRM}, (di/dt)c=1A/ms	2	—	—	V/μs
Transfer characteristics	Isolation resistance		R_{ISO}	DC500V, RH=40~60%	10^8	—	—	Ω
	Turn-on time		t_{on}	Ta=25°C	—	—	1	ms
	Turn-off time		t_{off}	Ta=25°C	—	—	14	ms
On-state power dissipation			P_{on}	Ta=85°C	—	—	1.5	W
Off-state power dissipation		S202D81	P_{off}	Ta=85°C, V_{OUT}=240V, 8ch.	—	—	0.4	W
		S201DX1		Ta=85°C, V_{OUT}=240V, 16ch.	—	—	0.8	W

■ Recommended Operating Conditions

Parameter	Symbol	MIN.	MAX.	Unit
Input signal voltage	V_{in}	3.0	5.5	V
Pick-up voltage	V_{pu}	—	3.0	V
Drop-out voltage	V_{do}	1.0	—	V
Load power supply voltage	V_{out}	10	240	Vrms
Frequency	f	45	65	Hz
Load power factor	cosφ	25	100	%

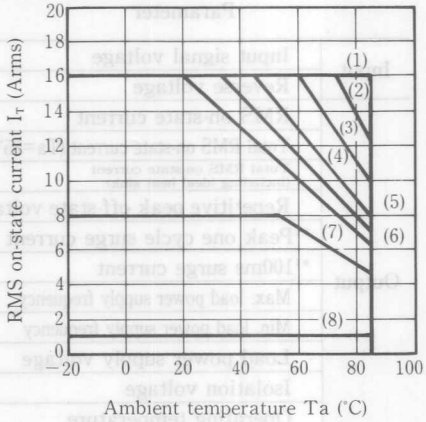
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Fig. 1 RMS On-state Current vs. Ambient Temperature (S202D81)



(1) With infinite heat sink (8ch. total)
(2) With heat sink (200×200×2mm Aℓ plate) (8ch. total)
(3) With heat sink (150×150×2mm Aℓ plate) (8ch. total)
(4) With heat sink (100×100×2mm Aℓ plate) (8ch. total)
(5) With heat sink (100×75×2mm Aℓ plate) (8ch. total)
(6) With heat sink (100×50×2mm Aℓ plate) (8ch. total)
(7) Without heat sink (8ch. total)
(8) Without heat sink (1ch. only)

Fig. 2 RMS On-state Current vs. Ambient Temperature (S201DX1)



(1) With infinite heat sink (16ch. total)
(2) With heat sink (200×200×2mm Aℓ plate) (16ch. total)
(3) With heat sink (150×150×2mm Aℓ plate) (16ch. total)
(4) With heat sink (100×100×2mm Aℓ plate) (16ch. total)
(5) With heat sink (100×75×2mm Aℓ plate) (16ch. total)
(6) With heat sink (100×50×2mm Aℓ plate) (16ch. total)
(7) Without heat sink (16ch. total)
(8) Without heat sink (1ch. only)

Fig. 3 Surge Current vs. Power-on Cycle

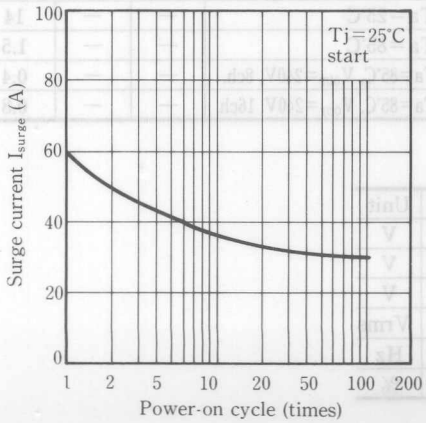


Fig. 4 On-state Power Dissipation vs. RMS On-state Current (S202D81)

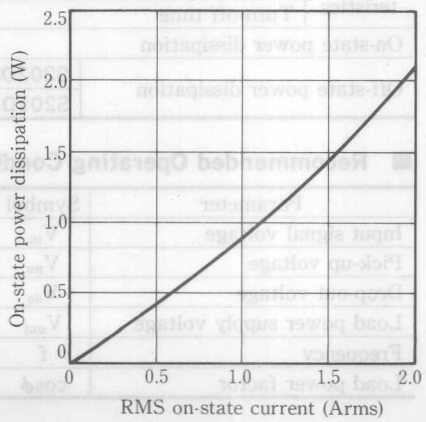


Fig. 5 On-state Power Dissipation vs. RMS On-state Current (S201DX1)

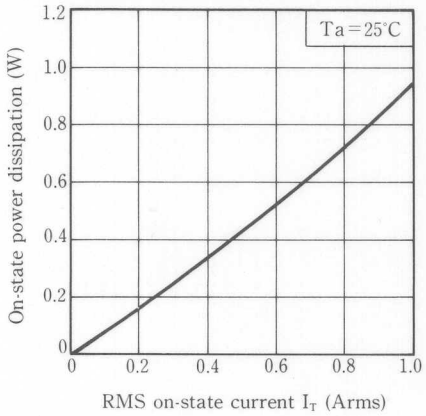


Fig. 6 Repetitive Peak off-state Current vs. Ambient Temperature

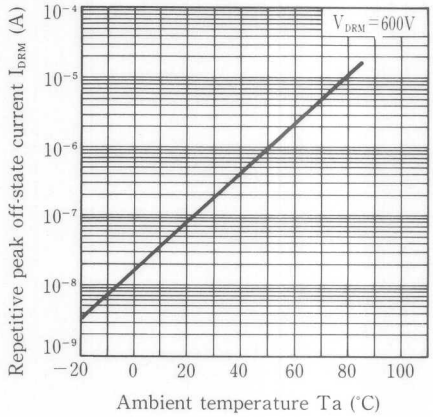


Fig. 7 Pick-up, Drop-out Voltage vs. Ambient Temperature (S202D81)

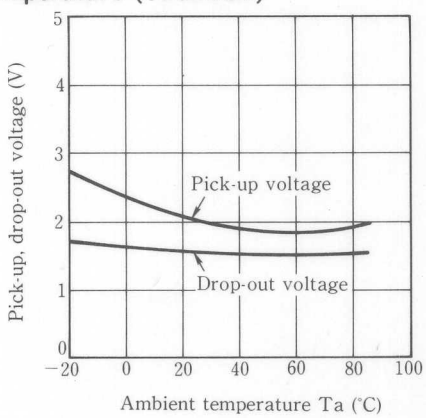


Fig. 8 Pick-up, Drop-out Voltage vs. Ambient Temperature (S201DX1)

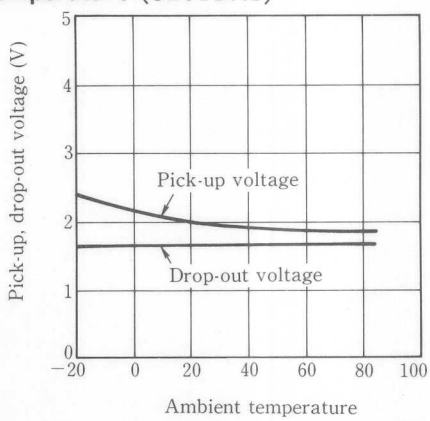
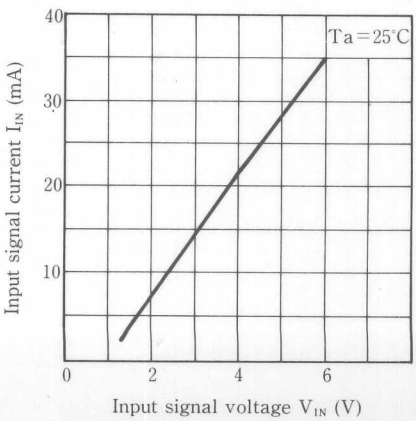


Fig. 9 Input Characteristics



8

Fig. 5 On-state Power Dissipation vs. RMS On-state Current (S201DX1)

Fig. 6 Repetitive Peak off-state Current vs. Ambient Temperature

Fig. 7 Pick-up, Drop-out Voltage vs. Ambient Temperature (S202D81)

Fig. 8 Pick-up, Drop-out Voltage vs. Ambient Temperature (S201DX1)

Fig. 9 Input Characteristics

Reference Data

9

9 Reference Data

■ Reference data parameter table

Classification	Parameter	Fig. No.	Corresponding Model
Photocoupler	Short-circuit current vs. forward current	1	PC713V
	Base-emitter current vs. base-emitter voltage	2	PC713V
	Relative collector current vs. base-emitter external resistor	3	PC713V
	Collector dark current vs. base-emitter external resistor	4	PC713V
	DC current amplification factor vs. base current	5	PC713V
	Base-emitter voltage vs. ambient temperature	6	PC713V
	Collector dark current vs. collector-emitter voltage	7	PC713V, PC817
Photothyristor coupler	Critical rate of rise of off-state voltage vs. gate capacitor	1	S12MD1V
	Critical rate of rise of off-state voltage vs. DC off-state voltage	2	S12MD1V
	Holding current vs. gate resistance	3	S12MD1V
	Turn-on time vs. gate resistance	4	S12MD1V
	Turn-on time vs. gate capacitor	5	S12MD1V
	Surge current vs. power cycling	6	S12MD1V
	Peak pulse voltage vs. capacitor (noise absorber)	7	S12MD1V
		8	S12MD1V
Photointerrupter	Relative collectior current vs. slit width · shielding width	1	GP1S50
	Relative collector current vs. slit width · reflecting width	2	GP2S01
		3	GP2S04
	Opaque characteristics	4	GP1S50

9—1 Photocoupler Reference Data

Fig. 1 Short-circuit current vs. forward current (PC713V)

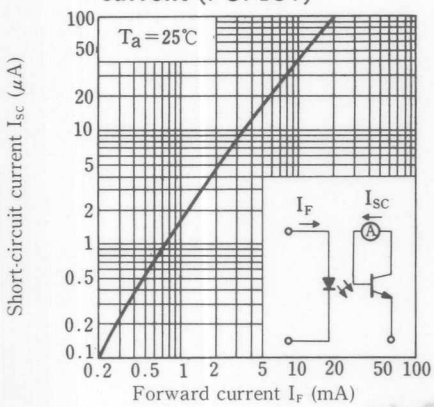


Fig. 2 Base-emitter current vs. base-emitter voltage (PC713V)

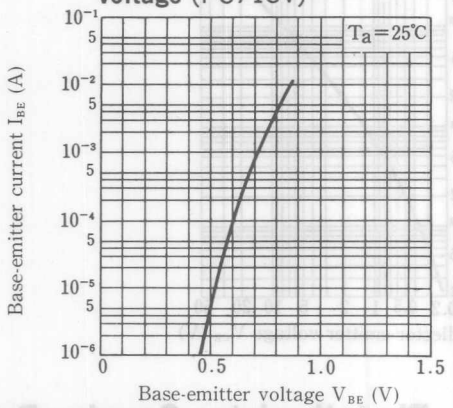


Fig. 3 Relative collector current vs. base-emitter external resistor (PC713V)

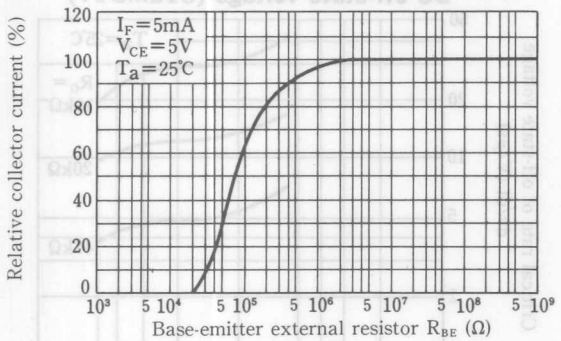


Fig. 4 Collector dark current vs. base-emitter external resistor (PC713V)

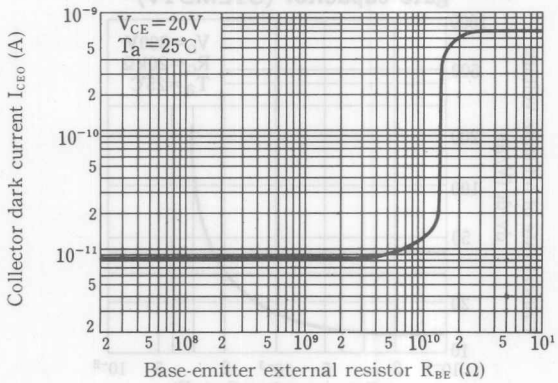


Fig. 5 DC current amplification factor vs. base current (PC713V)

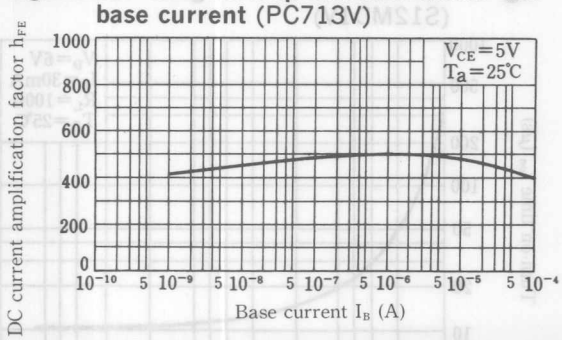
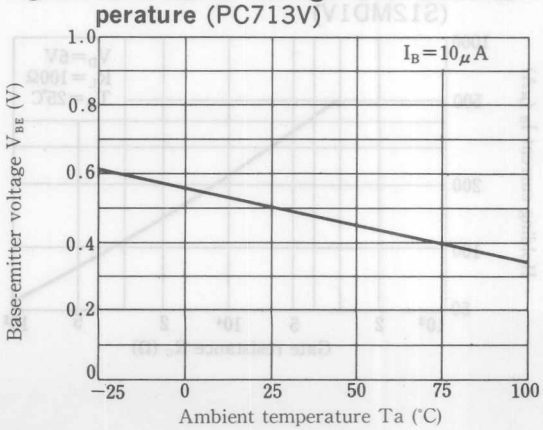
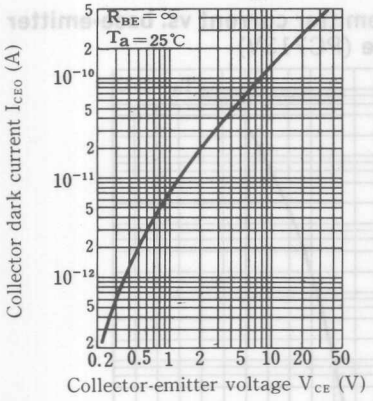


Fig. 6 Base-emitter voltage vs. ambient temperature (PC713V)



9

Fig. 7 Collector dark current vs. collector-emitter voltage (PC713V, PC817)



9—2 Photothyristor Coupler Reference Data

Fig. 1 Critical rate of off-state voltage vs. gate capacitor (S12MD1V)

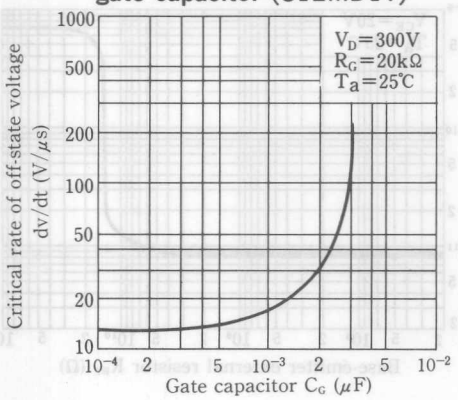


Fig. 2 Critical rate of off-state voltage vs. DC off-state voltage (S12MD1V)

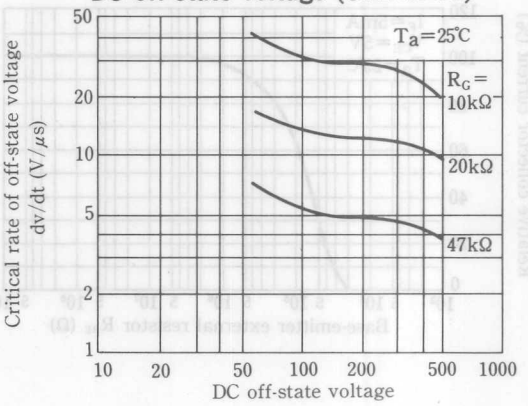


Fig. 3 Holding current vs. gate resistance (S12MD1V)

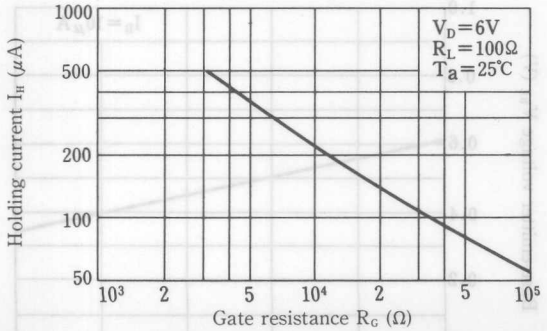


Fig. 4 Turn-on time vs. gate resistance (S12MD1V)

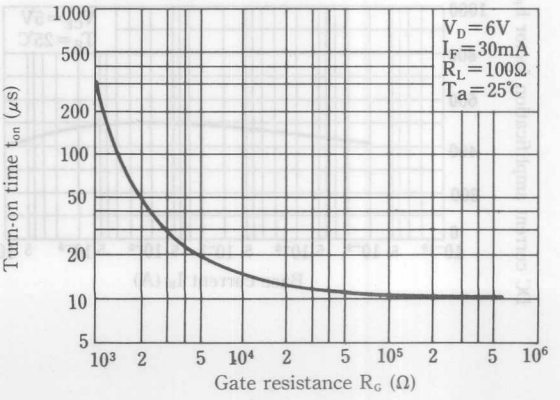


Fig. 5 Turn-on time vs. gate capacitance (S12MD1V)

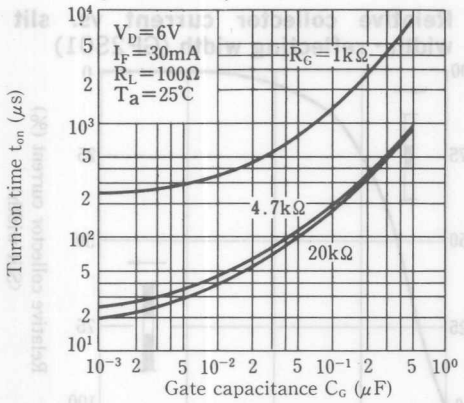


Fig. 6 Surge current vs. power cycling (S12MD1V)

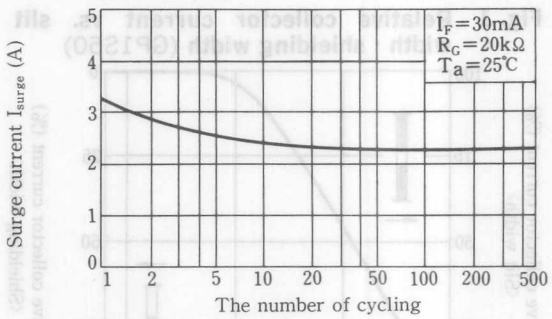


Fig. 7 Peak pulse voltage vs. capacitance (S12MD1V)

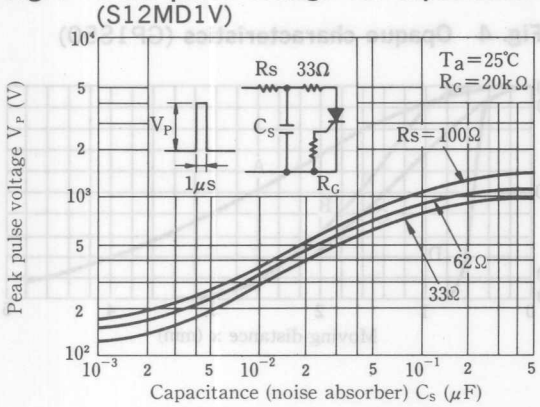
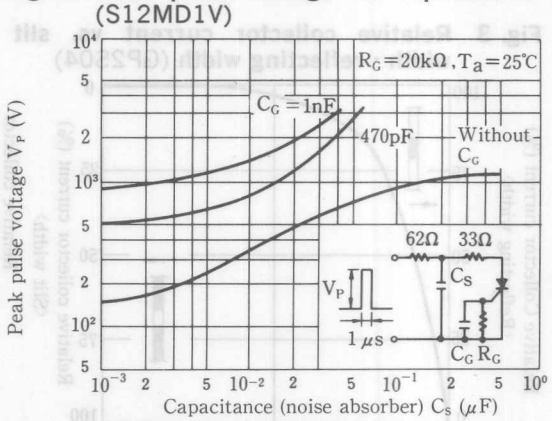


Fig. 8 Peak pulse voltage vs. capacitance (S12MD1V)



9

9—3 Photointerrupter Reference Data

Fig. 1 Relative collector current vs. slit width · shielding width (GP1S50)

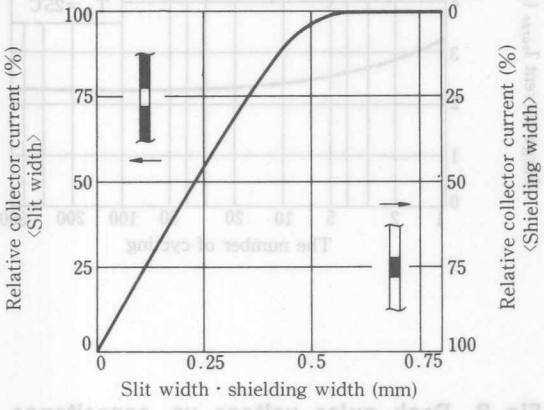


Fig. 2 Relative collector current vs. slit width · reflecting width (GP2S01)

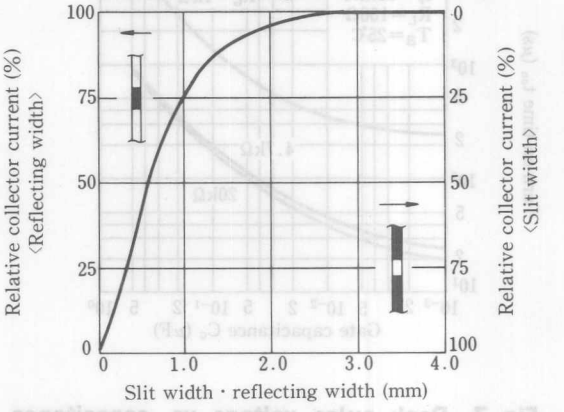


Fig. 3 Relative collector current vs. slit width · reflecting width (GP2S04)

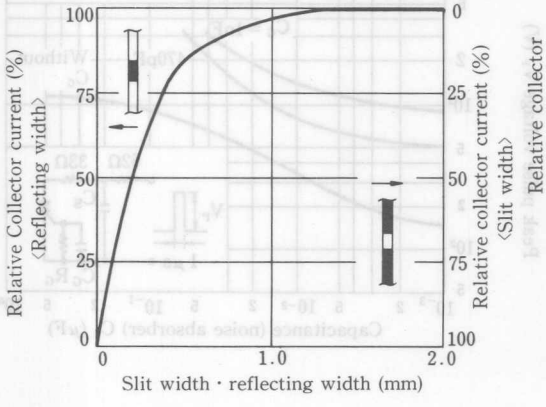
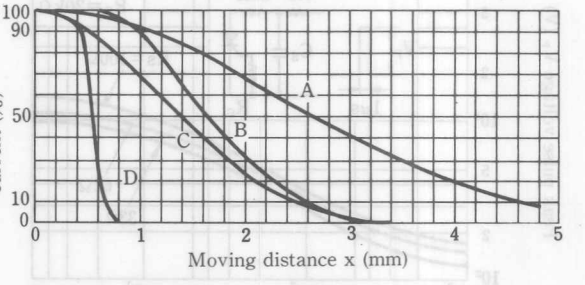
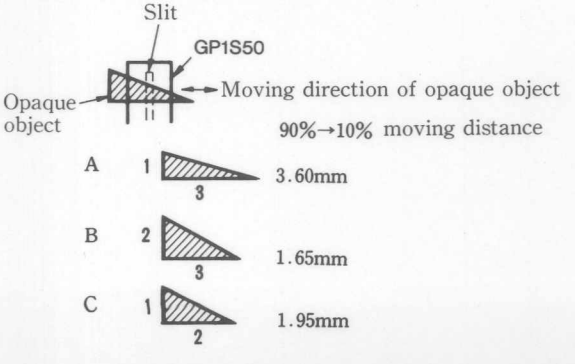
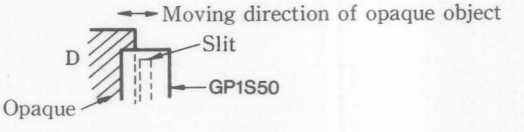


Fig. 4 Opaque characteristics (GP1S50)

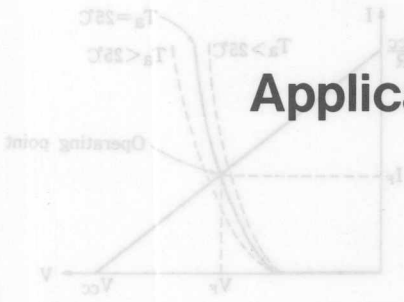


Test method for opaque characteristics





Application Circuits



10

10-1 Infrared light emitting diode application circuits

(1) Serial connection and parallel connection

Fig. 1 shows the most basic and commonly used circuits for driving light emitting diodes.

In Fig. 1(a), a constant voltage source (V_{CC}) is connected through a current limiting resistor (R) to an LED so that it is supplied with forward current (I_F). The I_F current flowing through the LED is expressed as $I_F=(V_{CC}-V_F)/R$, providing a radiant flux proportional to the I_F. The forward voltage (V_F) of the LED is dependent on the value of I_F, but it is approximately to a constant voltage when setting the R.

Figs. 1(b) and 1(c) show the circuits for driving LEDs in serial connection and parallel connection, respectively. In arrangement (b), the current flowing through the LED is expressed as $I_F=(V_{CC}-V_F \cdot N)/R$, while in arrangement (c), the current flowing through each LED is expressed as $I_F=(V_{CC}-V_F)/R$ and the total supply current is $N \times I_F$, where N is the number of LEDs.

The V_F of LED has a temperature dependency of approximately $-1.9mV/°C$. The operating point for load R varies in response to the ambient temperature as shown in Fig. 2.

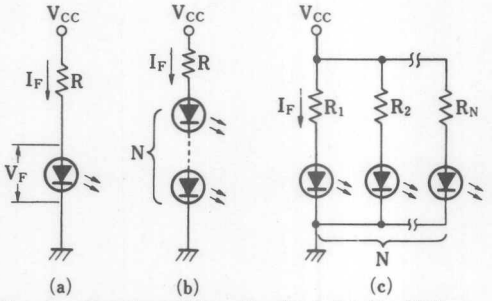


Fig. 1 Driving Circuit of Light Emitting Diode (LED)

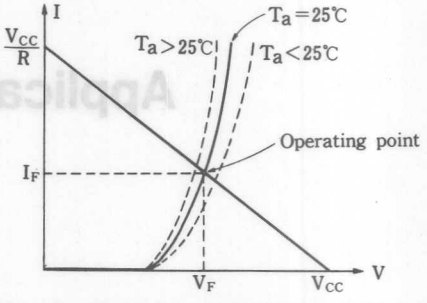


Fig. 2 Current vs. Voltage of Light Emitting Diode (LED)

(2) Constant current drive

To stabilize the radiant flux of the LED, the forward current (I_F) must be stabilized by using a constant current source.

Fig. 3 shows a circuit for constantly driving several LEDs using transistor. Transistor (Tr_1) is biased by a constant voltage supplied by a zener diode (ZD) so that the voltage across the emitter follower loaded resistor R_E is constant, thereby making the collector current ($I_C=I_F$) constant. The I_C is given an $I_C=I_E=(V_Z=V_{BE})/R_E$. If too many LEDs are connected, the transistor enters the saturation region and does not operate as a constant current circuit. The number of LEDs (N) which can be connected in serial is calculated by the following equations.

$$V_{CC}-N \cdot V_F-V_E>V_{CE}(sat)$$
$$V_E=V_Z-V_{BE}$$

These equations give:

$$N(V_{CC}-V_Z+V_{BE}-V_{CE}(sat))/V_F$$

Figs. 4 and 5 show other costant current driving circuits that use diodes or transistors, instead of zener diodes.

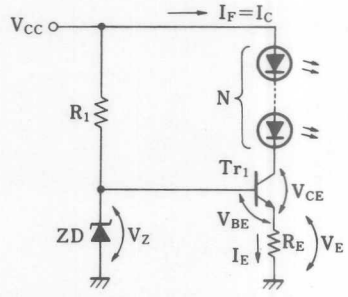


Fig. 3 Constant Current Driving Circuit (1)

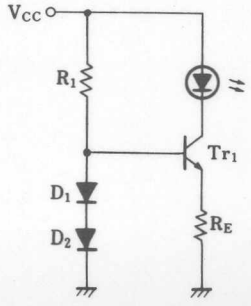


Fig. 4 Constant Current Driving Circuit (2)

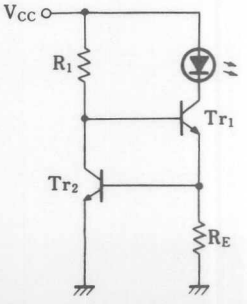


Fig. 5 Constant Current Driving Circuit (3)

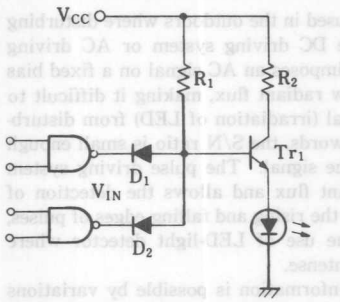


Fig. 6 Connection with the TTL Logic Circuit (1)

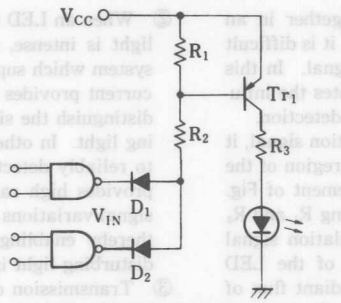


Fig. 7 Connection with the TTL Logic Circuit (2)

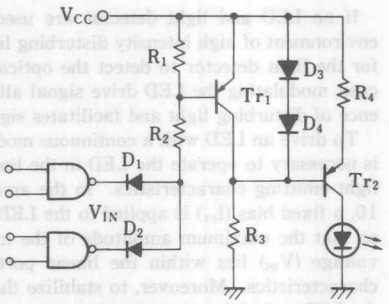


Fig. 8 Connection with the TTL Logic Circuit (3)

(3) Driving circuit activated by a logic IC

Figs. 6 and 7 show LED driving circuits that operate in response to digital signals provided by TTL or CMOS circuits.

Fig. 8 shows a driving circuits connected with an high level logic circuits.

In Fig. 6, a high input signal V_{IN} from a TTL circuit makes the NPN transistor (Tr_1) conductive so that the forward current (I_F) flows through the LED. Accordingly, this circuit operates in the positive logic mode, in which a high input activates the LED.

In Fig. 7, a low input signal V_{IN} from a TTL circuit makes the PNP transistor (Tr_1) conductive so that the forward current flows through the LED. This circuit operates in the negative logic mode, in which a low input activates the LED.

In Fig. 8, the circuit operates in the positive logic mode, and current I_F is stabilized by constant current driving so that the radiant flux of LED is stabilized against variations in the supply voltage (V_{CC}).

(4) Driving circuit with an AC signal

Fig. 9 (a) shows a circuit in which an AC power source supplies the forward current (I_{F1}) to an LED. A diode (D_1) in inverse parallel connection with the LED protects the LED against reverse voltage, suppressing the reverse voltage applied to the LED lower than V_{F2} by using reverse voltage protection diode of LED. The LED provides a radiant flux proportional to the applied AC current, (emitting only in half wave).

Fig. 9 (b) shows the driving waveform of the AC power source.

Fig. 10 (a) shows a driving circuit which modulates the radiant flux of LED in response to a sine wave or modulation signal. Fig. 10 (b) shows modulation operation.

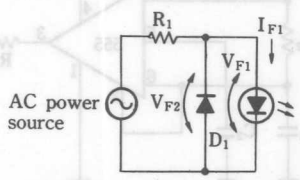


Fig. 9 (a) Driving Circuit with AC Power Source

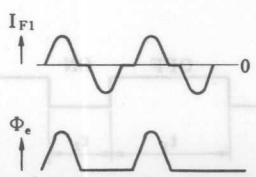


Fig. 9 (b) Driving Waveform

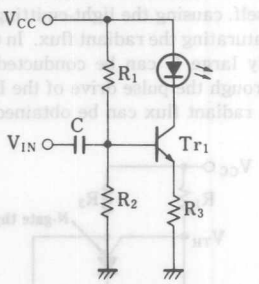


Fig. 10 (a) Modulation Driving Circuit

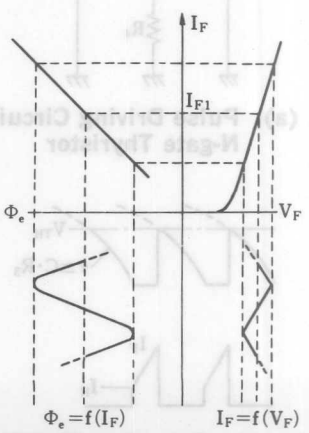


Fig. 10 (b) Modulation Operation

10

If an LED and light detector are used together in an environment of high intensity disturbing light, it is difficult for the light detector to detect the optical signal. In this case, modulating the LED drive signal alleviates the influence of disturbing light and facilitates signal detection.

To drive an LED with a continuous modulation signal, it is necessary to operate the LED in the linear region of the light emitting characteristics. In the arrangement of Fig. 10, a fixed bias (I_{F1}) is applied to the LED using R_1 and R_2 so that the maximum amplitude of the modulation signal voltage (V_{IN}) lies within the linear portion of the LED characteristics. Moreover, to stabilize the radiant flux of the LED, it is driven by a constant current by the constant current driving circuit shown in Fig. 3. The capacitor (c) used in Fig.10 (a) is a DC signal blocking capacitor.

(5) Pulse driving

LED driving systems fall into three categories : DC driving system, AC driving system (including modulation systems), and pulse driving system of these driving systems are most commonly employed.

Features of the pulse driving system:

① Large radiant flux

② Less influence of disturbing light

③ Information transmisson

① The radiant flux of the LED is proportional to its forward current (I_F),but in reality a large I_F heats up the LED by itself, causing the light-emitting efficiency to fall and thus saturating the radiant flux. In this circumstance, a relatively large I_F can be conducted with no risk of heating through the pulse drive of the LED. Consequently, a large radiant flux can be obtained.

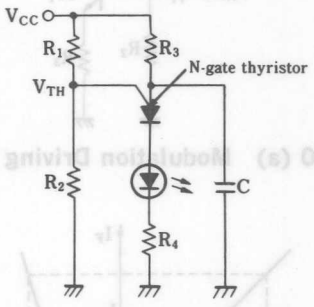


Fig. 11 (a) Pulse Driving Circuit Using N-gate Thyristor

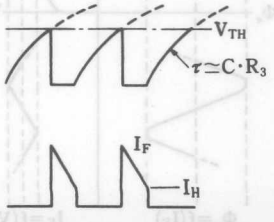


Fig. 11 (b) Operating Waveforms

② When an LED is used in the outdoors where disturbing light is intense, the DC driving system or AC driving system which superimposes an AC signal on a fixed bias current provides low radiant flux, making it difficult to distinguish the signal (irradiation of LED) from disturbing light. In other words, the S/N ratio is small enough to reliably detect the signal. The pulse driving system provides high radiant flux and allows the detection of signal variations at the rising and falling edges of pulses, thereby enabling the use of LED-light detector where disturbing light is intense.

③ Transmission of information is possible by variations in pulse width or counting of the number of pulse used to encode the LED emission.

Figs. 11 through 14 show the typical pulse driving circuit. Fig. 15 shows the pulse driving circuit used in the optical remote control. The circuit shown in Fig. 11 uses an N-gate thyristor with voltage between the anode and cathode oscillated at certain interval determined by the time constant of C · R so that the LED emits light pulse. To turn off the N-gate thyristor, resistor R_3 must be used so that the anode current is smaller than the holding current (I_H), i. e., $I_H > V_{CC}/R_3$. Therefore, the R_3 has large value, resulting in a large time constant ($\tau \simeq C \cdot R_3$). and the circuit operates for a relatively long period to provide short pulse widths. The circuit shown in Fig. 12 uses a type 555 timer IC to form an astable multivibrator to produce light pulses on the LED. The off-period (t_1) and the on-period (t_2) of the LED are calculated by the following equations.

$$t_1 = \ln 2 \cdot (R_1 + R_2) \cdot C_1$$

$$t_2 = \ln 2 \cdot R_2 \cdot C_1$$

The value of R_1 is determined so that the rating of I_{IN} of a 555 timer IC is not exceeded, i. e., $S_1 > V_{CC}/I_{IN}$.

This pulse driving circuit uses a 555 timer IC to provide wide variable range in the oscillation period and light-on time. It is used extensively.

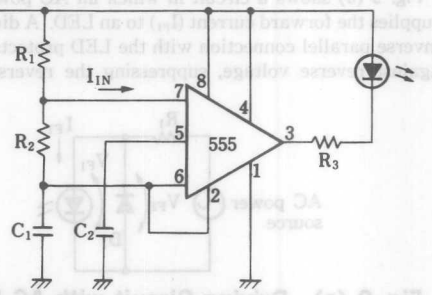


Fig. 12 (a) Pulse Driving Using a 555 Timer IC

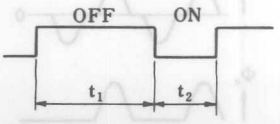


Fig. 12 (b) Output Waveform

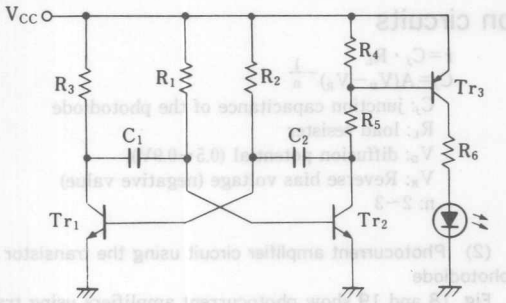


Fig. 13 (a) Pulse Driving Circuit Using Astable Multivibrator

The circuit shown in Fig. 13 uses transistors to form an astable multivibrator for pulse driving an LED. The off-period (t_1) of the LED is given by $C_1 \cdot R_1$, while its on-period (t_2) is given by $C_2 \cdot R_2$. For oscillation of this circuit, resistors must be chosen so that the R_1/R_3 and R_2/R_5 ratios are large.

The circuit shown in Fig. 14 uses a CMOS logic IC (inverter) to form an oscillation circuit for pulse driving an LED. The pulse driving circuit using a logic IC provides a relatively short oscillation period with a 50% duty cycle.

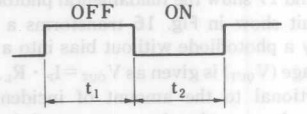


Fig. 13 (b) Output Waveform

Fig. 15(a) shows an LED pulse driving circuit used for the light projector of the optical remote control and optoelectronic switch. The circuit is arranged by combining two different oscillation circuits i. e., a long period oscillation (f_1) superimposed with a short period oscillation (f_2) as shown in Fig. 15(b). Frequencies f_1 and f_2 can be set independently.

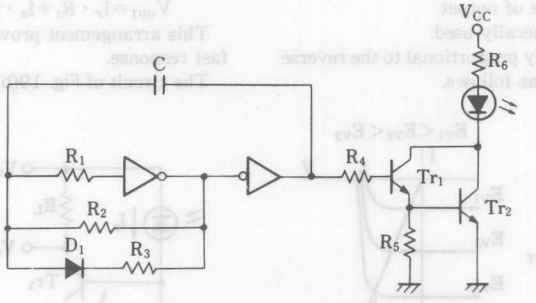


Fig. 14 Pulse Driving Circuit Using CMOS Logic IC

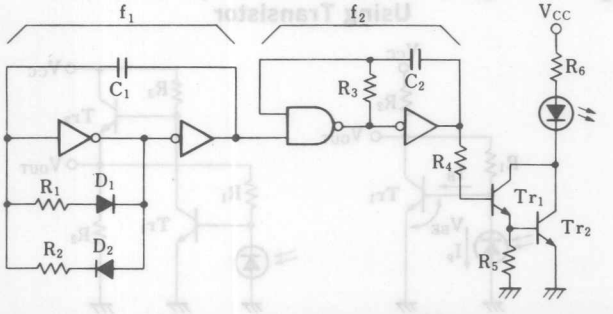


Fig. 15 (a) Pulse Driving Circuit

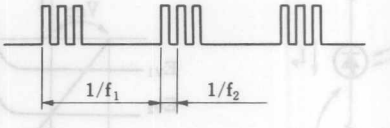


Fig. 15 (b) Output Waveform

10

10-2 Photodiode/Phototransistor application circuits

(1) Fundamental photodiode circuits

Figs. 16 and 17 show the fundamental photodiode circuits.

The circuit show in Fig. 16 transforms a photocurrent produced by a photodiode without bias into a voltage. The output voltage (V_{OUT}) is given as $V_{OUT}=I_P \cdot R_L$. It is more or less proportional to the amount of incident light when $V_{OUT}<V_{OC}$. It can also be compressed logarithmically relative to the amount of incident light when V_{OUT} is near V_{OC}. (V_{OC} is open-terminal voltage of a photodiode.)

Fig. 16(b) shows the operating point for a load resistor (R_L) without application of bias to the photodiode.

Fig. 17 shows a circuit in which the photodiode is reverse-biased by V_{CC} and a photocurrent (I_P) is transformed into an output voltage. Also in this arrangement, the V_{OUT} is given as $V_{OUT}=I_P \cdot R_L$. An output voltage proportional to the amount of incident light is obtained. The proportional region is expanded by the amount of V_{CC} {proportional regin: $V_{OUT}<(V_{OC}+V_{CC})$}. On the other hand, application of reverse bias to the photodiode causes the dark current (I_d) to increase, leaving a voltage of $I_d \cdot R_L$ when the light is interrupted, and this point should be noted in designing the circuit.

Fig. 17(b) shows the operating point for an load resistor R_L with reverse bias applied to the photodiode.

Features of a circuit used with a reverse-biased photodiode:

① High speed response

② Wide proportional range of output

Therefore, this circuit is generally used.

The response time is inversely proportional to the reverse bias voltage and is expressed as follows.

$$r=C_j \cdot R_L$$

$$C_j=A(V_D-V_R)^{-\frac{1}{n}}$$

C_j: junction capacitance of the photodiode

R_L: load resister

V_D: diffusion potential (0.5~0.9V)

V_R: Reverse bias voltage (negative value)

n: 2~3

(2) Photocurrent amplifier circuit using the transistor of photodiode

Fig. 18 and 19 show photocurrent amplifiers using transistors.

The circuit shown in Fig. 18 are most basic combinations of a photodiode and an amplifying transistor. In the arrangement of Fig. 18(a), the photocurrent produced by the photodiode causes the transistor (Tr_1) to decrease its output (V_{OUT}) from high to low. In the arrangement of Fig. 18(b), the photocurrent causes the V_{OUT} to increase from low to high. Resistor R_{BE} in the circuit is effective for suppressing the influence of dark current (I_d) and is chosen to meet the following conditions:

$$R_{BE}<V_{BD}/I_d$$

$$R_{BE}>V_{BE}/\{I_P-V_{CC}/(R_L \cdot h_{FE})\}$$

Fig. 19 shows simple amplifiers utilizing negative feedback.

In the circuit of Fig. 19(a), the output (V_{OUT}) is given as

$$V_{OUT}=I_P \cdot R_1+I_B \cdot R_1+V_{BE}$$

This arrangement provides a large output and relatively fast response.

The circuit of Fig. 19(b) has an addtional transistor (Tr_2)

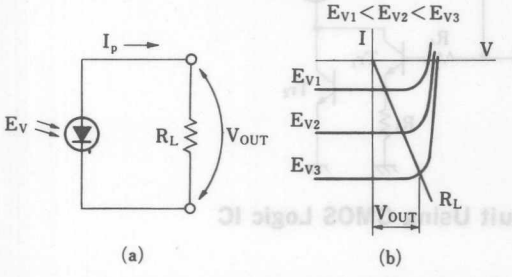


Fig. 16 Fundamental Circuit of Photodiode (without Bias)

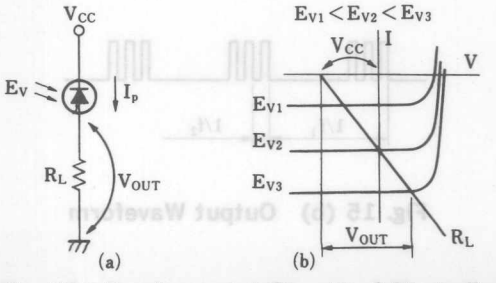


Fig. 17 Fundamental Circuit of Photodiode (with Bias)

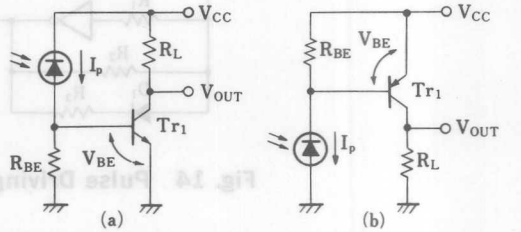


Fig. 18 Photocurrent Amplifier Circuit Using Transistor

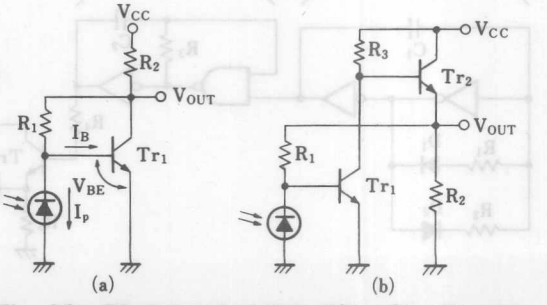


Fig. 19 Photocurrent Amplifier Circuit with Negative Feedback

to provide a larger output current.

(3) Amplifier circuit using operational amplifier

Fig. 20 shows a photocurrent-voltage conversion circuit using an operational amplifier. The output voltage (V_{OUT}) is given as $V_{OUT}=I_P \cdot R_1 (I_P \simeq I_{SC})$. The arrangement utilizes the characteristics of an operational amplifier with two input terminals at about zero voltage (imaginary grounded) to operate the photodiode without bias. It has no influence of dark current. The circuit provides an ideal short-circuit current (I_{SC}) in a wide operating range.

Fig. 20(b) shows the output voltage vs. radiant intensity characteristics. An arrangement with no bias and high impedance loading to the photodiode provides the following features.

① Less influence by dark current

② Wide linear range of the photocurrent relative to the radiant intensity.

Fig. 21 shows a logarithmic photocurrent amplifier using an operating amplifier. The circuit uses a logarithmic diode for the logarithmic conversion of photocurrent into an output voltage. In dealing with a very wide irradiation intensity range, linear amplification results in a saturation of output because of the limited linear region of the operational amplifier, whereas logarithmic compression of the photocurrent prevents the saturation of output. With its wide measurement range, the logarithmic photocurrent amplifier is used for the exposure meter of cameras.

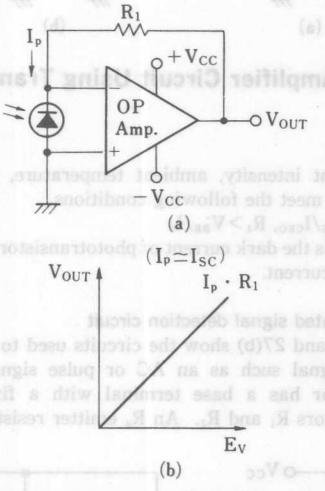


Fig. 20 Photocurrent Amplifier Using an Operational Amplifier (without Bias)

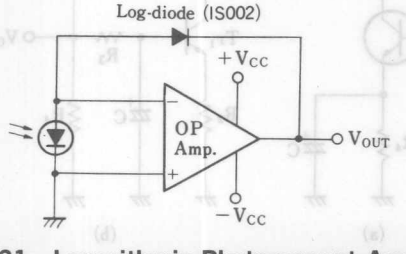


Fig. 21 Logarithmic Photocurrent Amplifier Using an Operational Amplifier

(4) Light detecting circuit for modulated light input

Fig. 22 show a light detecting circuit which uses an optical remote control to operate a television set, air conditioner, or other devices. Usually, the optical remote control is used in the sunlight or the illumination of a fluorescent lamp. To alleviate the influence of such an disturbing light, the circuit deals with pulse-modulation signals.

The circuit shows in Fig. 22 detects the light input by differentiating the rising and falling edges of a pulse signal. To amplify a very small input signal, an FET providing a high input impedance is used.

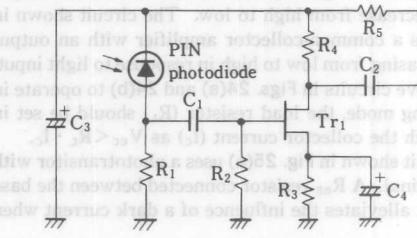


Fig. 22 Light Detecting Circuit for Modulated Light Input PIN Photodiode

(5) Color sensor amplifier circuit

Fig. 23 shows a color sensor amplifier using a semiconductor color sensor. Two short circuit currents (I_{SC1}, I_{SC2})

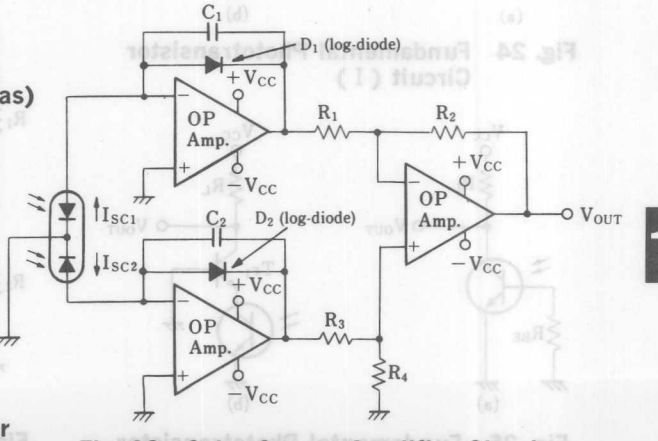


Fig. 23 Color Sensor Amplifier Circuit

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conducted by two photodiodes having different spectral sensitivities are compressed logarithmically and applied to a subtraction circuit which produces a differential output (V_{OUT}). The output voltage (V_{OUT}) is formulated as follows.

$$V_{OUT}=\frac{kT}{q}\cdot\log\left(\frac{I_{sc2}}{I_{sc1}}\right)\cdot A$$

Where A is the gain of the differential amplifier. The gain becomes $A=R_2/R_1$ when $R_1=R_3$ and $R_2=R_4$, then

$$V_{OUT}=\frac{kT}{q}\cdot\log\left(\frac{I_{sc2}}{I_{sc1}}\right)\cdot\frac{R_2}{R_1}$$

The output signal of the semiconductor color sensor is extremely low level. Therefore, great care must be taken in dealing with the signal. For example, low-biased, low-drift operational amplifiers must be used, and possible current leaks on the surface of P. W. B. must be taken into account.

(6) Fundamental phototransistor circuits

Figs. 24 and 25 show the fundamental phototransistor circuits. The circuit shown in Fig. 24(a) is a common-emitter amplifier. Light input at the base causes the output (V_{OUT}) to decrease from high to low. The circuit shown in Fig. 24(b) is a common-collector amplifier with an output (V_{OUT}) increasing from low to high in response to light input. For the above circuits in Figs. 24(a) and 24(b) to operate in the switching mode, the load resistor (R_L) should be set in relation with the collector current (I_C) as $V_{CC}<R_L\cdot I_C$.

The circuit shown in Fig. 25(a) uses a phototransitor with a base terminal. A R_{BE} resistor connected between the base and emitter alleviates the influence of a dark current when operating at a high temperature. The circuit shown in Fig. 25(b) features a cascade connection of the grounded-base transistor (Tr_1) so that the phototransistor is virtually less loaded, thereby improving the response.

(7) Amplifier circuit using transistor

Figs. 26(a) and 26(b) show the transistor amplifers used to amplify the collector current of the phototransistor using a transistor (Tr_1). The circuit in Fig. 26(a) increases the output from high to low in response to a light input, while the Fig. 26(b) circuit increases output from low to high in response to light input. The value of resistor R_1 depends on the input light intensity, ambient temperature, response speed, etc., to meet the following conditions.

$R_1<V_{BE}/I_{CEO}$, $R_1>V_{BE}/I_C$

Where I_{CBO} is the dark current of phototransistor and I_C is the collector current.

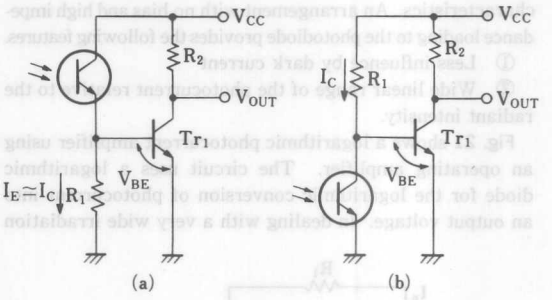


Fig. 26 Amplifier Circuit Using Transistor

(8) Modulated signal detection circuit

Figs. 27(a) and 27(b) show the circuits used to detect a modulated signal such as an AC or pulse signal. The phototransistor has a base terminal with a fixed bias through resistors R_1 and R_2. An R_4 emitter resistor main-

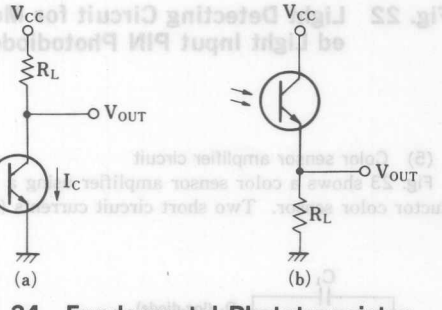


Fig. 24 Fundamental Phototransistor Circuit (I)

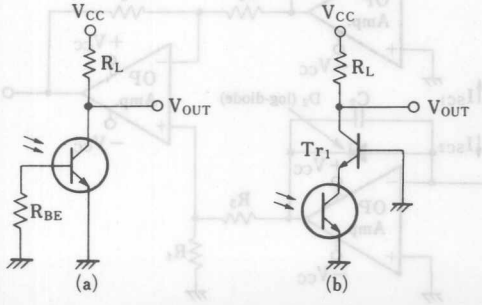


Fig. 25 Fundamental Phototransistor Circuit (II)

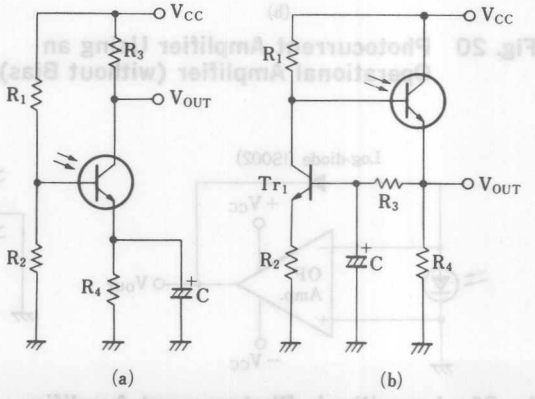


Fig. 27 Modulated Signal Detection Circuit

tains the DC output voltage constant. A modulated signal provides a base current through bypass capacitor C causing current amplification so that the signal greatly amplified.

(9) Amplifier circuit using operational amplifier

Fig. 28 shows a current-voltage conversion circuit using an operational amplifier. Its output voltage (V_{OUT}) is expressed as $V_{OUT} = I_C \cdot R_1$.

The current-voltage conversion circuit for the phototransistor is basically identical to that for the photodiode, except that the phototransistor requires a bias. The circuit shown in Fig. 28(a) has a negative bias (−V) for the emitter against the virtually grounded collector potential. Fig. 28(b) shows the output voltage vs. irradiation intensity characteristics.

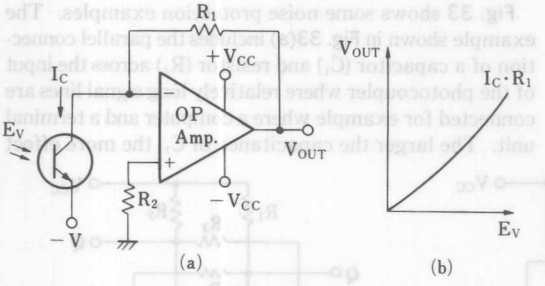


Fig. 28 Amplifier Circuit Using an Operational Amplifier

(10) Auto-stroboscope circuit

Fig. 29 shows the auto-stroboscope circuit of the current cut type. This circuit is most frequency used because of advantages such as continuous light emission and lower battery power consumption.

When the switch is the ON-state, the SCR_2 and SCR_3 turn on to discharge capacitor C_4 so that the xenon lamp is energized for to emit light. The anode of the SCR_2 is then reverse-biased, causing it to turn off and light emission of the xenon lamp ceases. The irradiation time is set automatically in response so variations in the cellector current of the phototransistor. This follows the intensity of reflected light from the object and the value of C_1 in the circuit. In other words, the irradiation time is long for a distant object, and short for a near object.

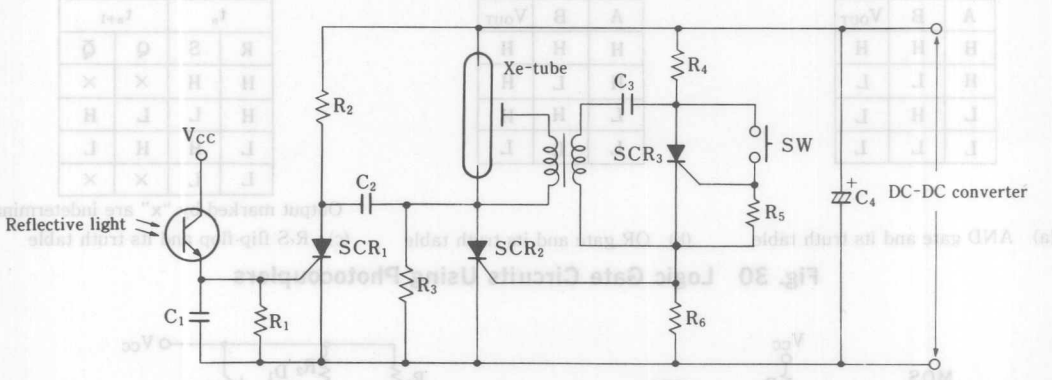


Fig. 29 Auto-stroboscope Circuit

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10-3 Photocoupler/Photothyristor coupler/Phototriac coupler application circuits

For the effective use of photocouplers, the usage utilizing the features and fundamental circuits using photocouplers are described as below.

(1) Logic gate circuit using photocouplers

Fig. 30 shows logic gates using photocouplers and their associated truth tables. The circuit of Fig. 30(a) forms an AND gate while the circuit of Fig. 30(b) forms an OR gate. These circuits are converted to a NAND gate and NOR gate, respectively, when the R_L load resistor are connected to the collector.

(2) Level conversion circuit

Fig. 31 shows simple level converters using a photocoupler. The circuit simple level converters using a photocoupler. The circuit shown in Fig. 31 (a) converts the MOS level to the TTL level. Because of the small output current from the MOS IC, a photocoupler with a high current transfer ratio (CTR) at low input is required.

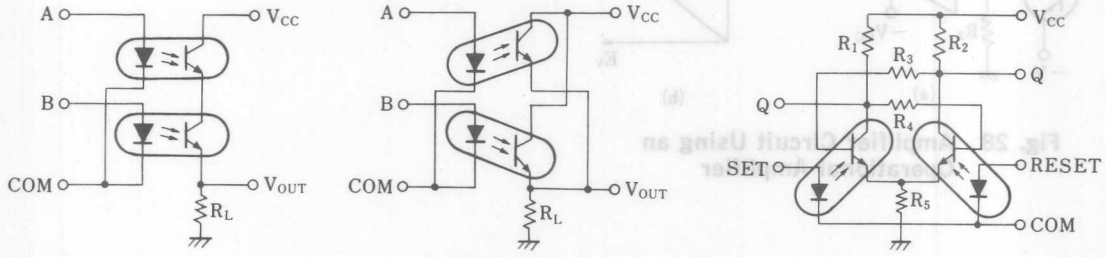
The circuit shown in Fig. 31(b) is a Schmitt trigger arranged using a photocoupler and transistor and an convert a signal into an arbitrary level.

(3) Isolation amplifier

Fig. 32 shows a non-modulated isolation amplifier operable with low-frequency signals. In the arrangement, the photocoupler input is biased by DC forward current which is superimposed by a low-frequency signal. This gives the operating region of the good linearity of photocoupler. The DC bias current is adjusted by VR_1.

(4) Noise protection

Fig. 33 shows some noise protection examples. The example shown in Fig. 33(a) includes the parallel connection of a capacitor (C_1) and resistor (R_1) across the input of the photocoupler where relatively long signal lines are connected for example where a computer and a terminal unit. The larger the capacitance of C_1, the more effect



A	B	V_{OUT}
H	H	H
H	L	L
L	H	L
L	L	L

(a) AND gate and its truth table

A	B	V_{OUT}
H	H	H
H	L	H
L	H	H
L	L	L

(b) OR gate and its truth table

t_n		t_{n+1}	
R	S	Q	$\overline{Q}$
H	H	×	×
H	L	L	H
L	H	H	L
L	L	×	×

Output marked by "x" are indeterminate

(c) R-S flip-flop and its truth table

Fig. 30 Logic Gate Circuits Using Photocouplers

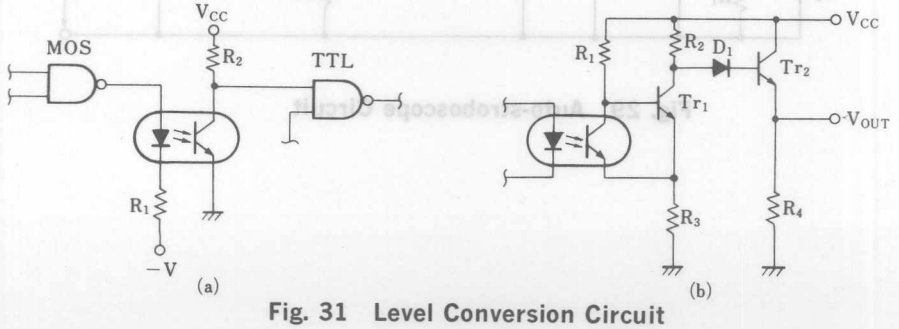


Fig. 31 Level Conversion Circuit

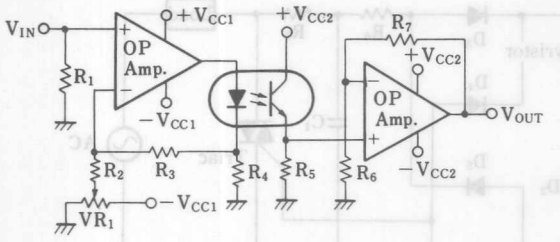


Fig. 32 Isolation Amplifier

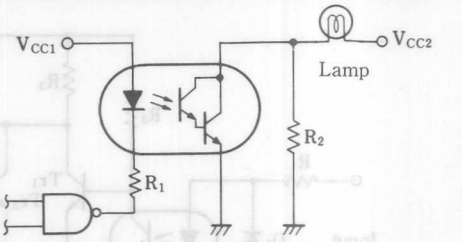


Fig. 34 Lamp Driving Circuit

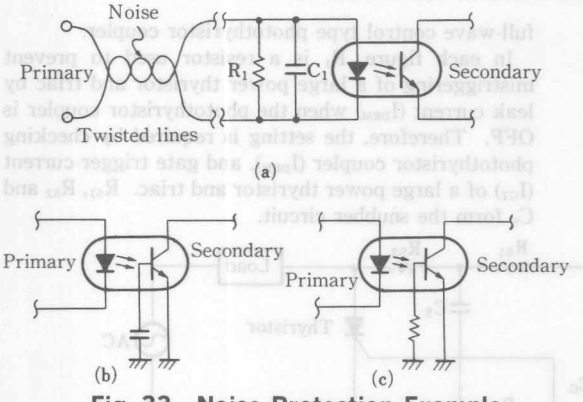


Fig. 33 Noise Protection Example

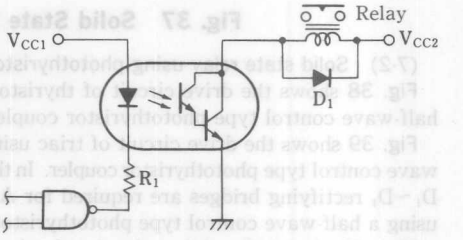


Fig. 35 Relay Driving Circuit

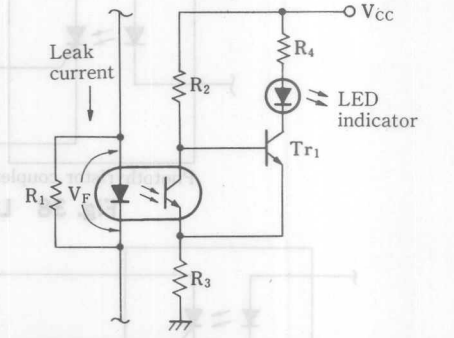


Fig. 36 Current Monitoring Circuit

is expected, although signal propagation time is sacrificed.

The examples in Figs. 33(b) and 33(c) use a photocoupler with a base terminal. Example (b) is effective against noise, but only in exchange for the response time, while example (c) tends to have low current transfer ratio (CTR).

However, when the photocoupler is operated in the switching mode, the base terminal tends to be affected by noise. Therefore, the use of photocouplers without a base terminal is recommended.

(5) Lamp driving circuit and relay driving circuit

Figs. 34 and 35 show circuits for driving a lamp and relay, respectively, directly at the output of the photocoupler.

For this purpose, a photocoupler is suitable including a Darlington transistor providing a high CTR. The circuit shown in Fig. 34 includes a R_2 resistor for supplying a preheating current to the lamp so as to prevent a rush current in lighting the lamp. The circuit in Fig. 35 includes a diode D_1 for suppressing a counter-electromotive voltage produced when the relay is under the OFF-state.

(6) Current monitoring circuit

The current monitoring circuit shown in Fig. 36 is designed to detect and indicate leak current in a circuit using a photocoupler. The LED indicator lights off if the leak current exceeds the V_F/R_1 value.

(7) Solid state relay

(7-1) Solid state relay using photocoupler

Fig. 37 shows a solid state relay circuit using a photocoupler. Fig. 37 includes an input circuit, photocoupler, thyristor for triggering, rectifying diode bridge, snubber circuit, and high power triac. In operation, the photocoupler turns on the thyristor for triggering and its ON-current activates the high power triac to drive the load. Because of a low collector withstand voltage and the low output current of the photocoupler, a thyristor for triggering is needed to interface it with a power control devices such as a power triac or power thyristor.

By appropriately choosing the R_1 and R_2 values, a high sensitive solid state relay having a wide range of input signal of the photocoupler type is realized. The zero-cross voltage is determined from the voltage division ratio by R_4 and R_5.

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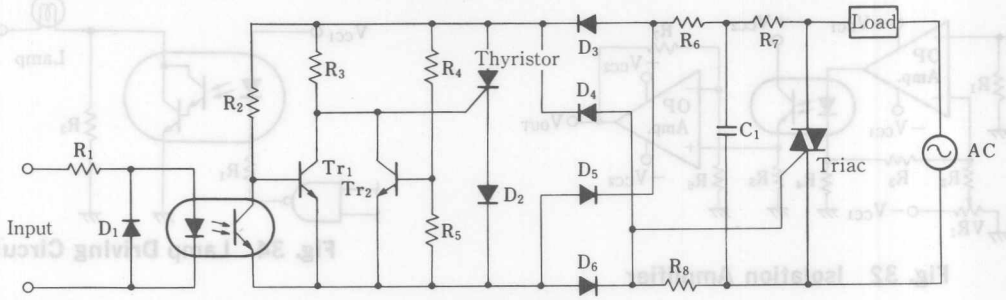


Fig. 37 Solid State Relay with Built-in Zero-cross Circuit

(7-2) Solid state relay using photothyristor coupler

Fig. 38 shows the drive circuit of thyristor using a half-wave control type photothyristor coupler.

Fig. 39 shows the drive circuit of triac using a half-wave control type photothyristor coupler. In this circuit, $D_1 \sim D_4$ rectifying bridges are required for AC control using a half-wave control type photothyristor coupler.

Fig. 40 shows the drive circuit of triac using a full-wave control type photothyristor coupler.

In each figure, R_1 is a resistor used to prevent mistriggering of a large power thyristor and triac by leak current (I_{DRM}) when the photothyristor coupler is OFF. Therefore, the setting is required by checking photothyristor coupler (I_{DRM}), and gate trigger current (I_{GT}) of a large power thyristor and triac. R_{S1}, R_{S2} and C_S form the snubber circuit.

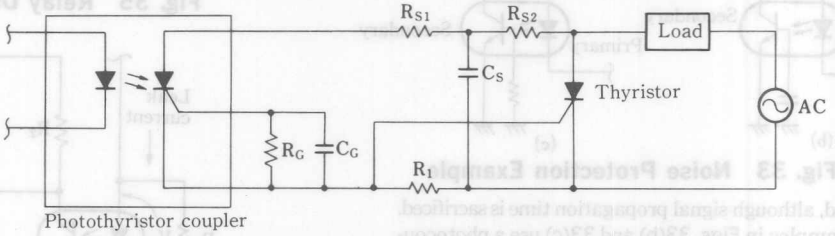


Fig. 38 Large Power Thyristor Drive Circuit

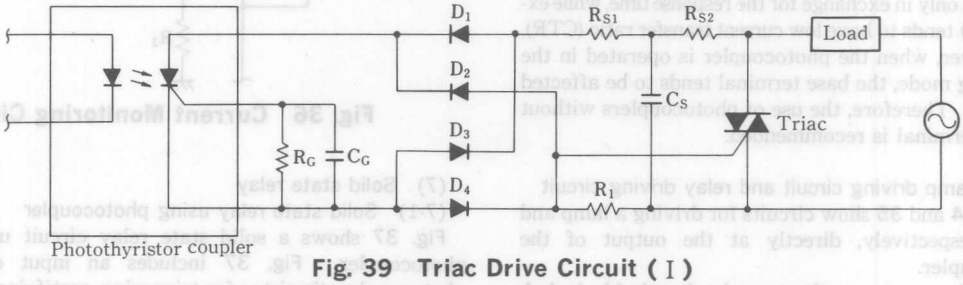


Fig. 39 Triac Drive Circuit (I)

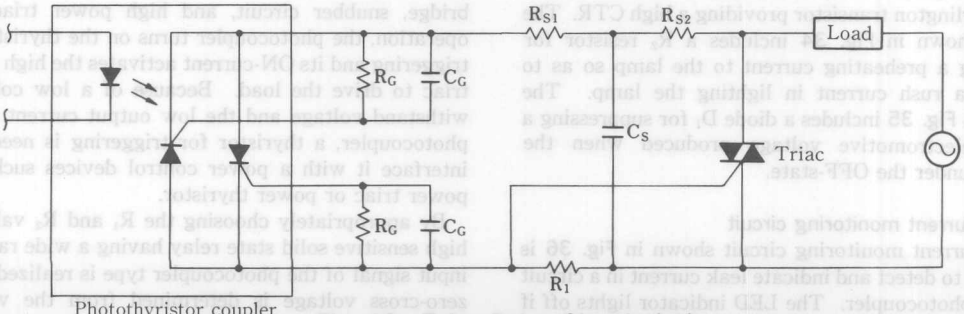
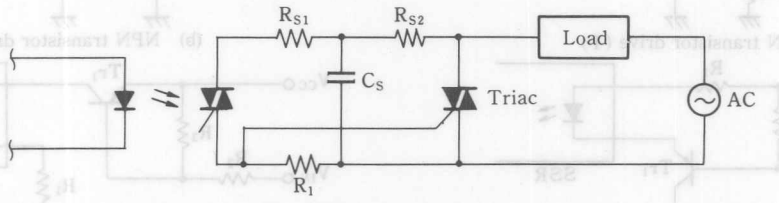


Fig. 40 Triac Drive Circuit (II)

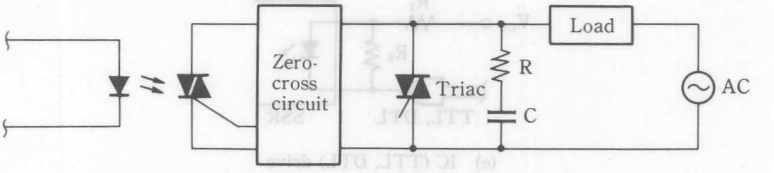
(7-3) Solid state relay using phototriac coupler

Fig. 41 shows a basic operation circuit of triac using a phototriac coupler.

Fig. 42 shows a circuit example of controlling forward and reverse rotation of the motor, using a control signal as one example of phototriac coupler application circuit.



(Zero-cross circuit is not built-in.)



(Zero-cross circuit is built-in.)

Fig. 41 Triac Drive Circuit (III)

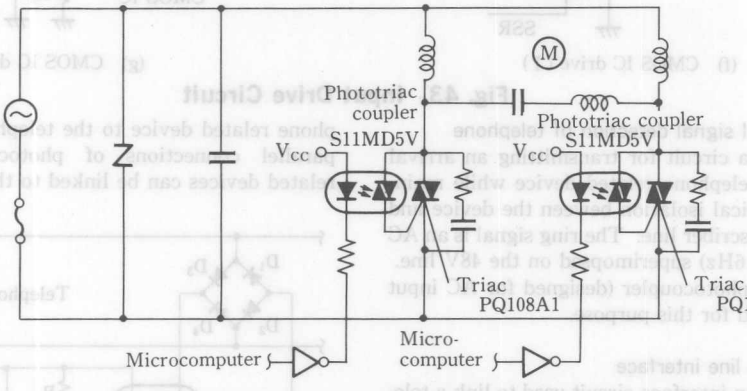


Fig. 42 Motor Drive Circuit

(7-4) Input drive circuit

Fig. 43 shows the input drive circuit of solid state relay (SSR). (a) and (b) operate with a positive signal, and (c) and (d) operate with a negative signal. (b) and (c) are effective when the output current of control circuit is small.

(e) is a drive circuit using IC (TTL/DTL), which operates when IC is in "L"-state.

(f) and (g) are drive circuits using CMOS IC, each of which cannot drive the primary side of SSR with CMOS IC only; it therefore drives via a transistor.

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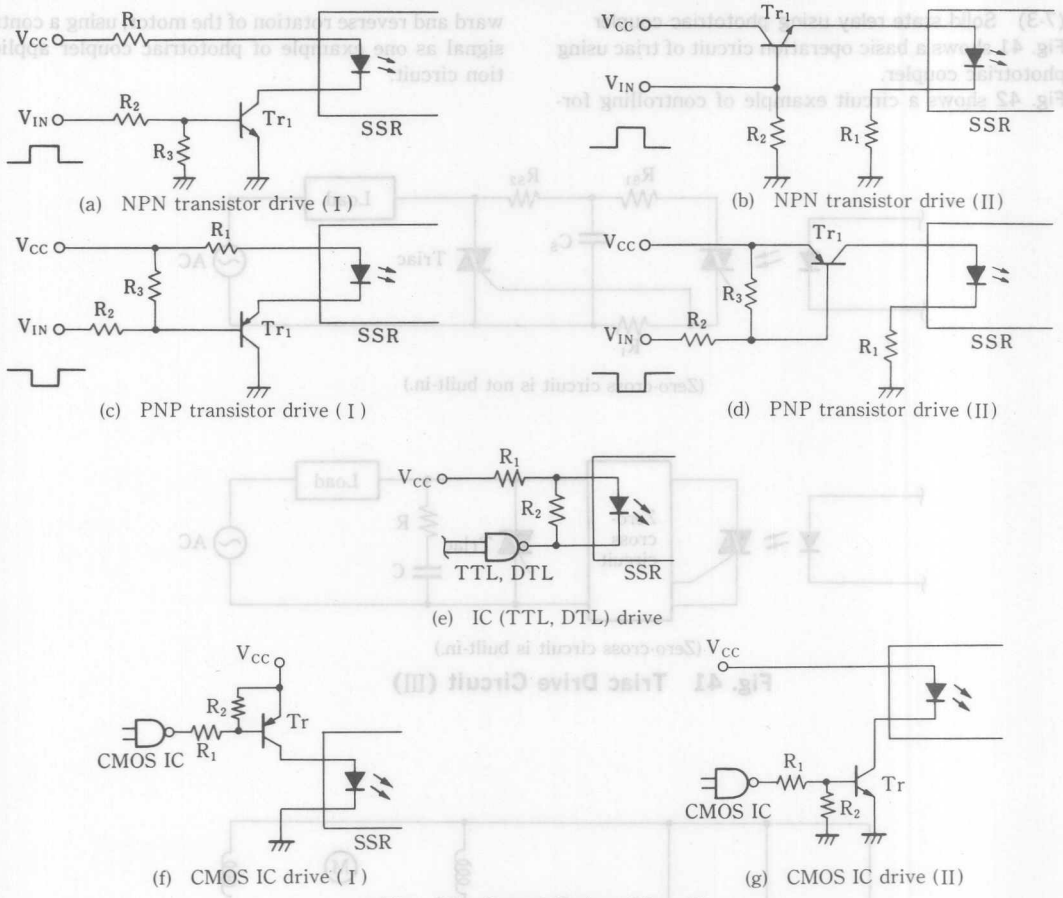


Fig. 43 Input Drive Circuit

(8) Arrival bell signal detection of telephone

Fig. 44 shows a circuit for transmitting an arrival bell signal to a telephone related device while maintaining the electrical isolation beween the device and the telephone subscriber line. The ring signal is an AC signal (75Vrms, 16Hz) superimopsed on the 48V line.

Non-polarized photocoupler (designed for AC input response) is suited for this purpose.

(9) Telephone line interface

Fig. 45 shows an interface circuit used to link a telephone related device to the telephone line. Through parallel connections of photocouplers, telephone related devices can be linked to the telephone line.

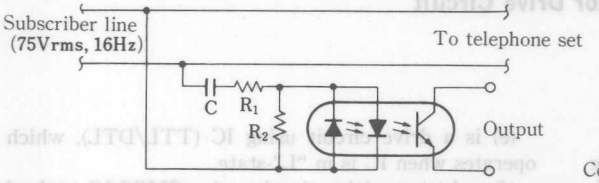


Fig. 44 Telephone Arrival Bell Signal Detection

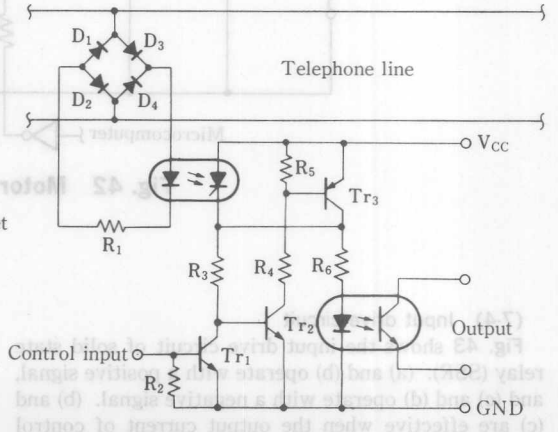


Fig. 45 Telephone Line Interface

(10) Telephone line polarity detection (ring counter)

Fig. 46 shows an example of a photocoupler used for the polarity detecting circuit in telephone line.

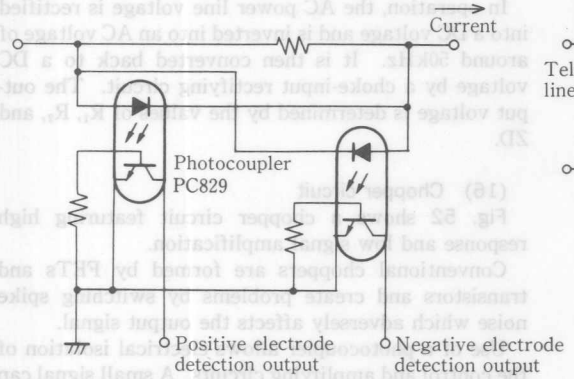


Fig. 46 Telephone Line Polarity Detection Circuit

(11) Dial pulse monitor circuit

Fig. 47 shows an example in which a photocoupler is actuated due to dial pulse current if the circuit is connected to the telephone line, the light detector side of photocoupler operates as a dial pulse monitor circuit.

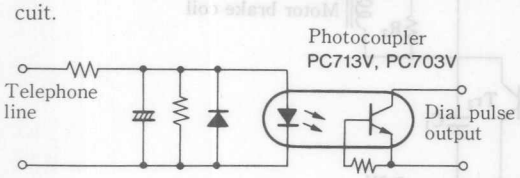


Fig. 47 Dial Pulse Monitor Circuit

(12) Power control circuit by bell signal

Fig. 48 shows an application example for ON/OFF switching of the power supply of a particular equipment by a telephone bell signal.

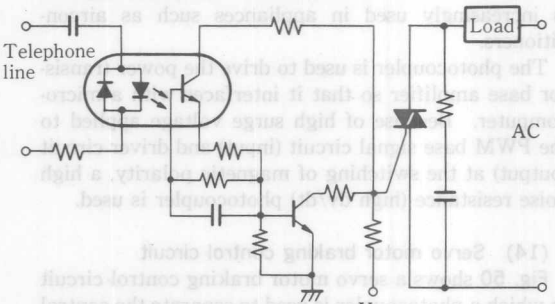


Fig. 48 Power Control Circuit by Bell Signal

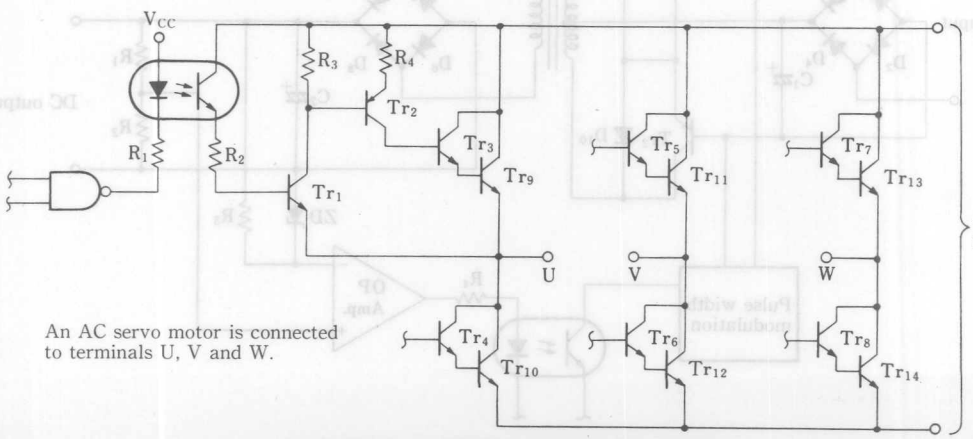


Fig. 49 Servo Motor Driving Circuit

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(13) Servo motor driving circuit

Fig. 49 shows an inverter-type AC servo motor speed control circuit. A transistorized inverter is featured to readily control an AC motor in a wide speed range. It is increasingly used in appliances such as air-conditioners.

The photocoupler is used to drive the power transistor base amplifier so that it interfaces with a microcomputer. Because of high surge voltage applied to the PWM base signal circuit (input) and driver circuit (output) at the switching of magnetic polarity, a high noise resistance (high dv/dt) photocoupler is used.

(14) Servo motor braking control circuit

Fig. 50 shows a servo motor braking control circuit in which a photocoupler is used to separate the control circuit from the brake driving circuit. A serial connection of C_2 and R_7 across the coil is designed to absorb the inductive current by the coil. C_1 is used to absorb high frequency noise on the DC power line.

(15) Switching regulator circuit

Fig. 51 shows a switching regulator curcuit using a photocoupler.

In operation, the AC power line voltage is rectified into a DC voltage and is inverted into an AC voltage of around 50kHz. It is then converted back to a DC voltage by a choke-input rectifying circuit. The output voltage is determined by the values of R_1, R_2, and ZD.

(16) Chopper circuit

Fig. 52 shows a chopper circuit featuring high response and low signal amplification.

Conventional choppers are formed by FETs and transistors and create problems by switching spike noise which adversely affects the output signal.

Use of a photocoupler allows electrical isolation of the control and amplifying circuits. A small signal can then readily be amplified with no affect from spike noise.

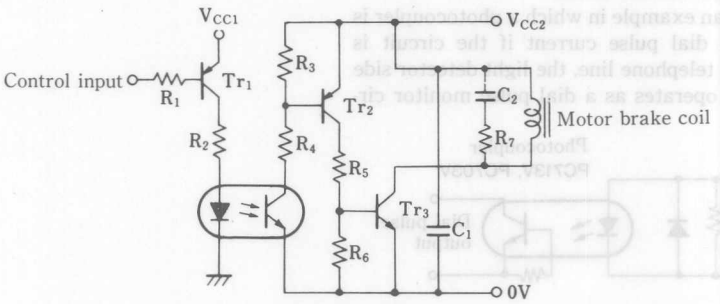


Fig. 50 Servo Motor Brake Control Circuit

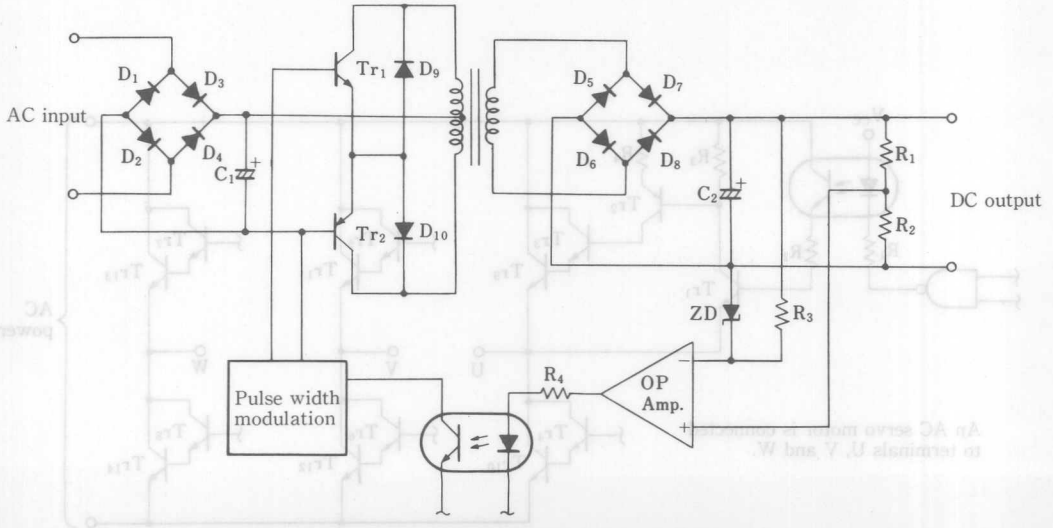


Fig. 51 Switching Regulator Circuit

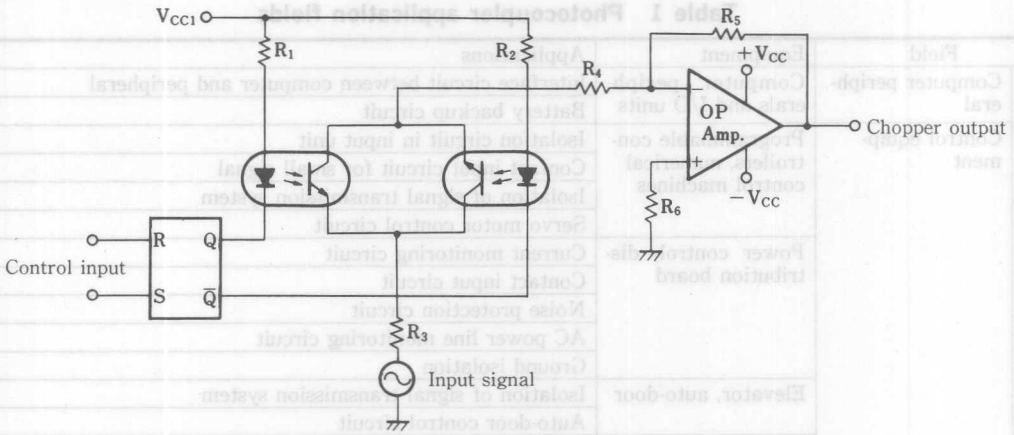


Fig. 52 Chopper Circuit

(17) Electrostatic printer control circuit

In the electrostatic printer, the print head driving circuit which operates at high voltage is separated from the control circuit.

A photocoupler with a high isolation voltage between the input and output is useful in the electrostatic printer control circuit.

Fig. 53 shows an electrostatic printer control circuit using a photocoupler.

(18) Photocoupler application fields

Table 1 summarizes the industrial applications of the photocouper.

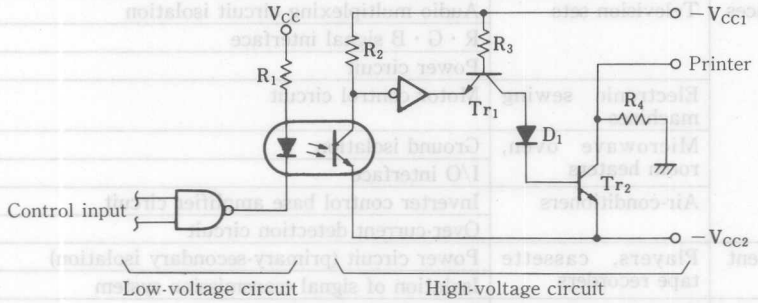


Fig. 53 Electrostatic Printer Control Circuit

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Table 1 Photocoupler application fields

Field		Equipment	Applications
A	Computer peripheral	Computer peripherals and I/O units	Interface circuit between computer and peripheral
			Battery backup circuit
B	Control equipment	Programmable controllers, numerical control machines	Isolation circuit in input unit
			Contact input circuit for small signal
			Isolation of signal transmission system
			Servo motor control circuit
		Power control, distribution board	Current monitoring circuit
			Contact input circuit
			Noise protection circuit
			AC power line monitoring circuit
			Ground isolation
		Elevator, auto-door	Isolation of signal transmission system
			Auto-door control circuit
		Others	Self-hold switch circuit
			Lamp and relay driving circuit
C	Instrument	Measuring, testing instruments	Isolation of signal transmission system (line driver, line receiver)
			I/O isolation of isolation amplifier
			Inductive noise protection circuit
			Level conversion circuit
D	Office equipment	Copiers, facsimiles	Ground isolation
			Power circuit (primary-secondary isolation)
		Printers	High voltage control circuit of electrostatic printer
			Printer drive circuit
			I/O interface
E	Automatic vendors		I/O interface
			Commodity/ticket selection circuit
F	Home appliances	Television sets	Audio multiplexing circuit isolation
			R · G · B signal interface
			Power circuit
		Electronic sewing machines	Motor control circuit
		Microwave oven, room heaters	Ground isolation
			I/O interface
		Air-conditioners	Inverter control base amplifier circuit
			Over-current detection circuit
G	Audio equipment	Players, cassette tape recorders	Power circuit (primary-secondary isolation)
			Isolation of signal transmission system
H	Telephone sxstem	Telephone sets	Dial pulse monitoring circuit
			Ring signal counter circuit
			Chiming circuit
			Modem switching circuit
		Exchangers	Subscriber line/control system separation
I	Power supply unit	Switching regulators	Pulse width modulation circuit
			Feedback circuit
			Isolation between primary and secondary
J	Others	SSR	Isolation between primary and secondary
		Motor control	Over-current detection circuit of induction motor
			Braking control circuit of servo motor
			Chopper circuit

10-4 Photointerrupter application circuits

Photointerrupters are used to detect the passage of, existence of an object. Accordingly, an output digital signal, i.e., high or low, is required in most applications.

Photointerrupters fall into two categories: transmissive and reflective. Many variations in performance, such as detecting gap width, resolution and focal distance are provided to meet various application needs.

The fundamental circuits for operating a photointerrupter are described below.

(1) DC signal processing circuits

Fig. 54 shows signal processing circuits for a transmissive type photointerrupter.

This type of photointerrupter provides an output signal with a relatively large S/N ratio, allowing detection of an object with a simple circuit as shown below. Circuits (a), (b) and (c) are used with a logic circuit, while (d) is used in the case of a large current leaks. The voltage division by resistors R_3 and R_4 determine the threshold level of detection.

(2) AC signal processing circuits

Fig. 55 shows the signal processing circuits of a reflective type photointerrupter.

This type of photointerrupter provides a very small output signal with an inferior S/N ratio. Therefore, the AC signal processing circuit eliminates, disturbing light and amplifies only a varying signal.

Circuit (a) is fixed level slicing. (b) is a floating level slicing, and (c) is light level compensating circuit.

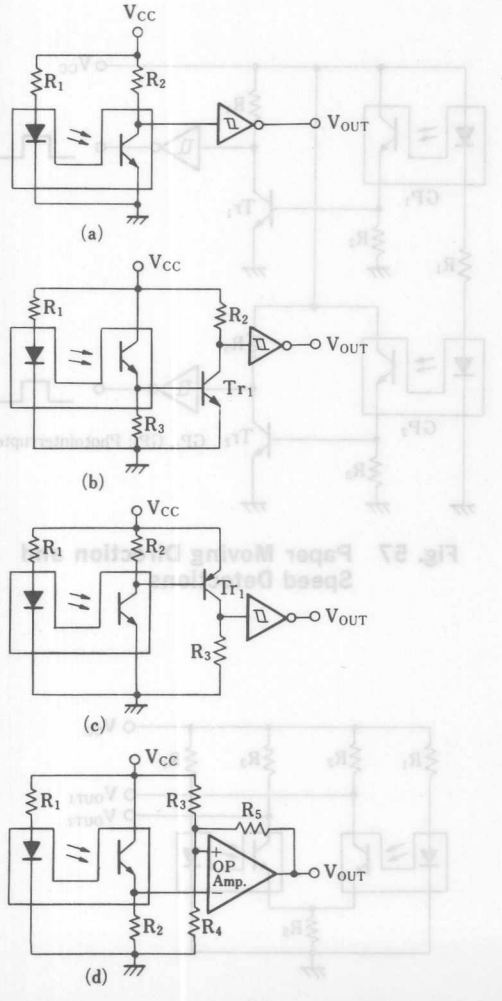


Fig. 54 DC Signal Processing Circuits

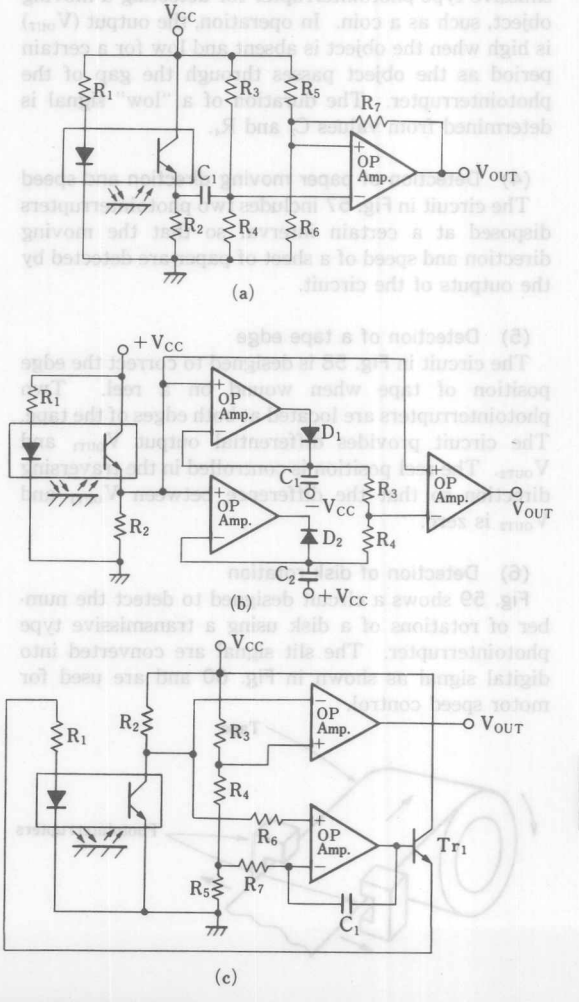


Fig. 55 AC Signal Processing Circuits

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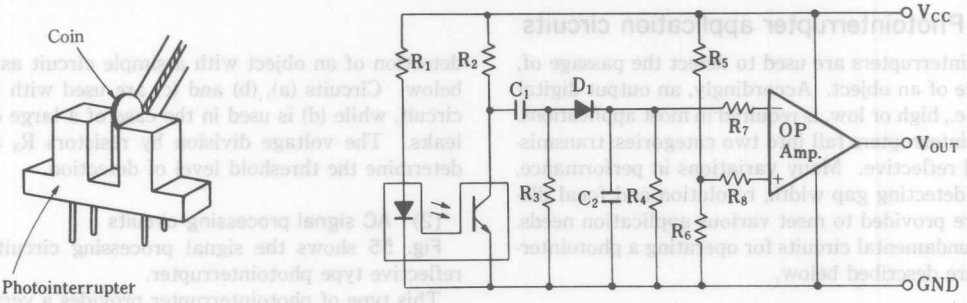


Fig. 56 Detection of Moving Objects

(3) Detection of moving objects

Fig. 56 shows a circuit example including a transmissive type photointerrupter for detecting a moving object, such as a coin. In operation, the output (V_{OUT}) is high when the object is absent and low for a certain period as the object passes through the gap of the photointerrupter. The duration of a "low" signal is determined from values C_2 and R_4.

(4) Detection of paper moving direction and speed

The circuit in Fig. 57 includes two photointerrupters disposed at a certain interval so that the moving direction and speed of a sheet of paper are detected by the outputs of the circuit.

(5) Detection of a tape edge

The circuit in Fig. 58 is designed to correct the edge position of tape when wound on a reel. Two photointerrupters are located at both edges of the tape. The circuit provides differential output V_{OUT1} and V_{OUT2}. The reel position is controlled in the traversing direction so that the difference between V_{OUT1} and V_{OUT2} is zero.

(6) Detection of disk rotation

Fig. 59 shows a circuit designed to detect the number of rotations of a disk using a transmissive type photointerrupter. The slit signal are converted into digital signal as shown in Fig. 60 and are used for motor speed control.

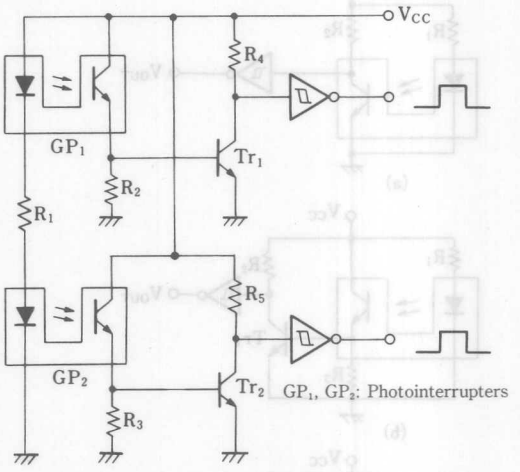
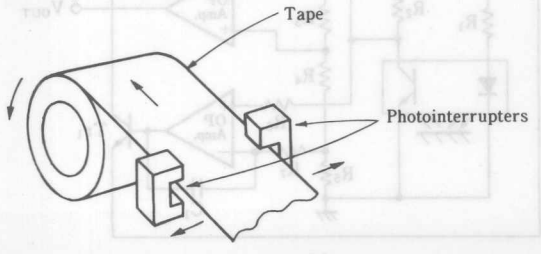


Fig. 57 Paper Moving Direction and Speed Detections



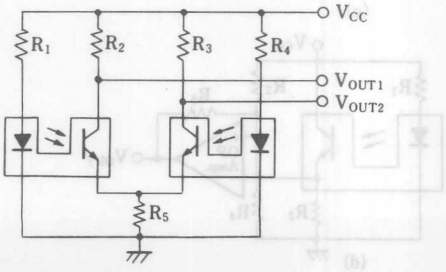


Fig. 58 Tape Edge Detection

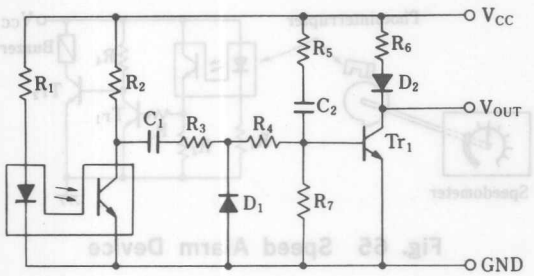


Fig. 59 Detection of Disk Rotation

(7) Detection of arm angle in record player

Fig. 61 shows a mechanism for correcting the angular deflection of the player tone arm using the differential outputs of two photointerrupters so that the tone arm is always parallel to the tangent of the grooves in the disk.

(8) Detection of cassette tape end

Fig. 62 shows a circuit designed to detect the end of cassette tape using a reflective tape photointerrupter so that the tape driving motor is deactivated at the end of the tape.

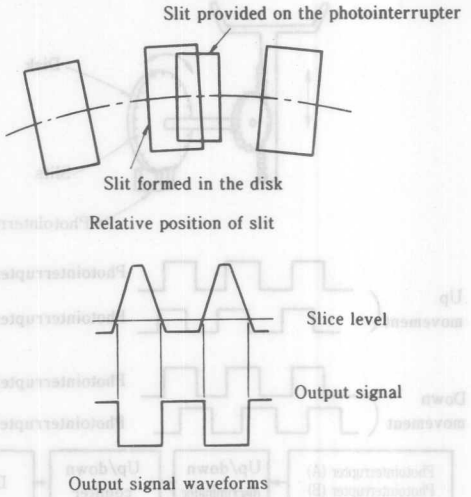
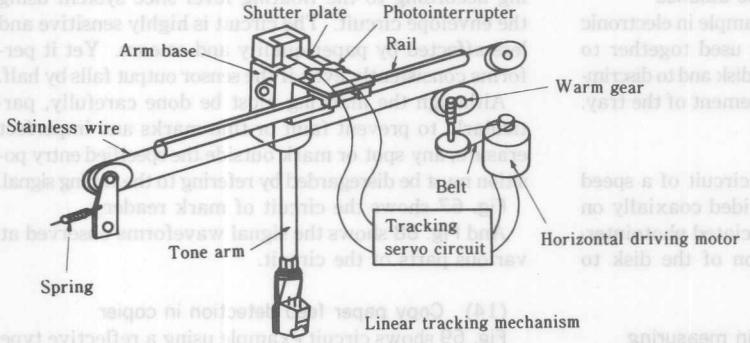


Fig. 60 Detected Signal Waveform Using Disk



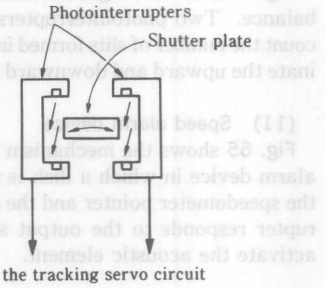


Fig. 61 Arm Angle Position Detection in Record Player

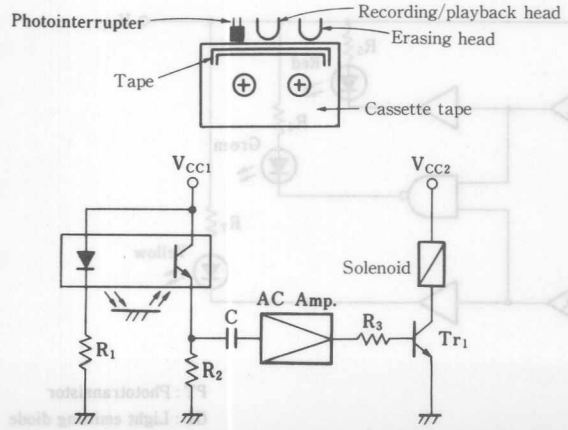
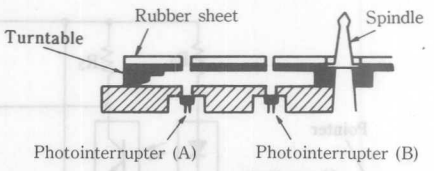


Fig. 62 Tape End Detection in Cassette Desk



Disk size	Photointerrupter (A)	Photointerrupter (B)	Instruction
None	OFF	OFF	Do not lower the tone arm
30cm disk	ON	ON	30cm disk position detecting circuit: ON, 33 1/3 rpm
17cm disk	OFF	ON	17cm disk position detecting circuit: ON, 45rpm

Fig. 63 Disk Size Detection

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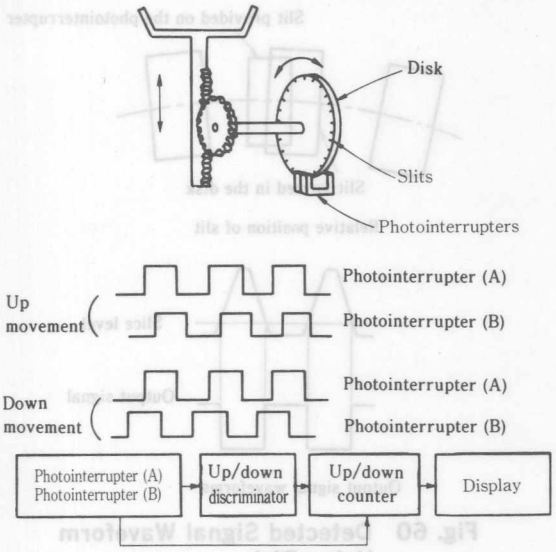


Fig. 64 Weight Detection in Electronic Balance

(10) Weight detection in electronic balance

Fig. 64 shows a weight detection example in electronic balance. Two photointerrupters are used together to count the number of slits formed in the disk and to discriminate the upward and downward movement of the tray.

(11) Speed alarm device

Fig. 65 shows the mechanism and circuit of a speed alarm device in which a disk is provided coaxially on the speedometer pointer and the associated photointerrupter responds to the output section of the disk to activate the acoustic element.

(12) Upper/lower limit detection in measuring instrument

Fig. 66 shows a mechanism and circuit for detecting

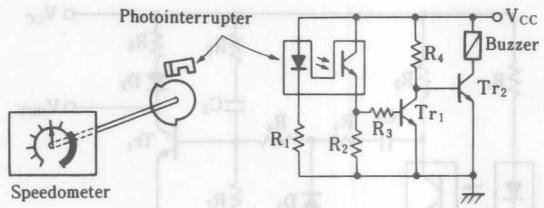


Fig. 65 Speed Alarm Device

the upper and lower limit on the instrument scale indicated by the pointer. The instrument pointer is provided with a mask tab which moves in the gap of the photointerrupters located at the upper and lower limit positions of the scale. The circuit lights a red LED when the pointer reaches the upper limit, a yellow LED when the lower limit is reached, or a green LED when the pointer is within the proper range.

(13) Card mark reader

Fig. 67 shows a card mark detecting circuit operating according to the floating level slice system using the envelope circuit. The circuit is highly sensitive and less affected by paper quality and smears. Yet it performs consistently even if the sensor output falls by half.

Although the marking must be done carefully, particularly to prevent faint or thin marks and imperfect erasure, any spot or mark outside the specified entry position must be disregarded by refering to the timing signal.

Fig. 67 shows the circuit of mark reader.

And Fig. 68 shows the signal waveforms observed at various parts of the circuit.

(14) Copy paper feed detection in copier

Fig. 69 shows circuit example using a reflective type photointerrupter designed to detect paper feed from the paper stocker.

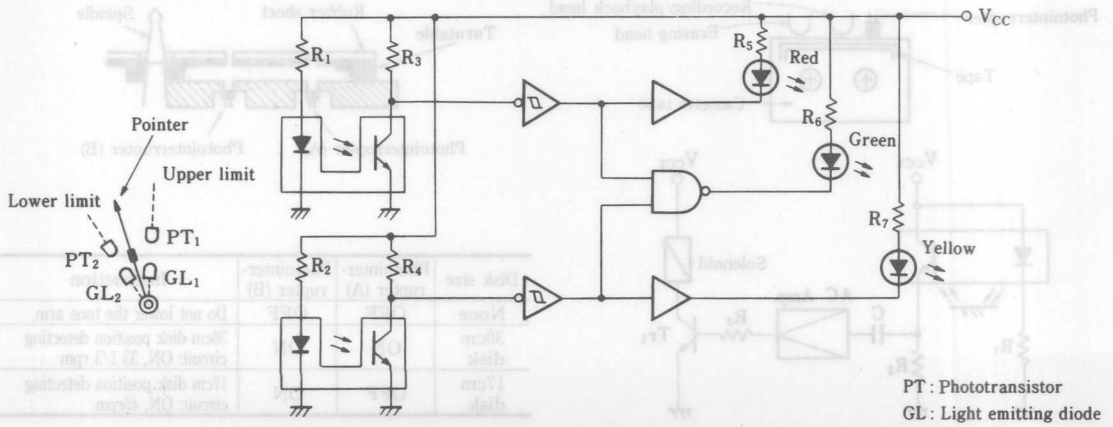


Fig. 66 Upper/lower Limits Detection in Instrument

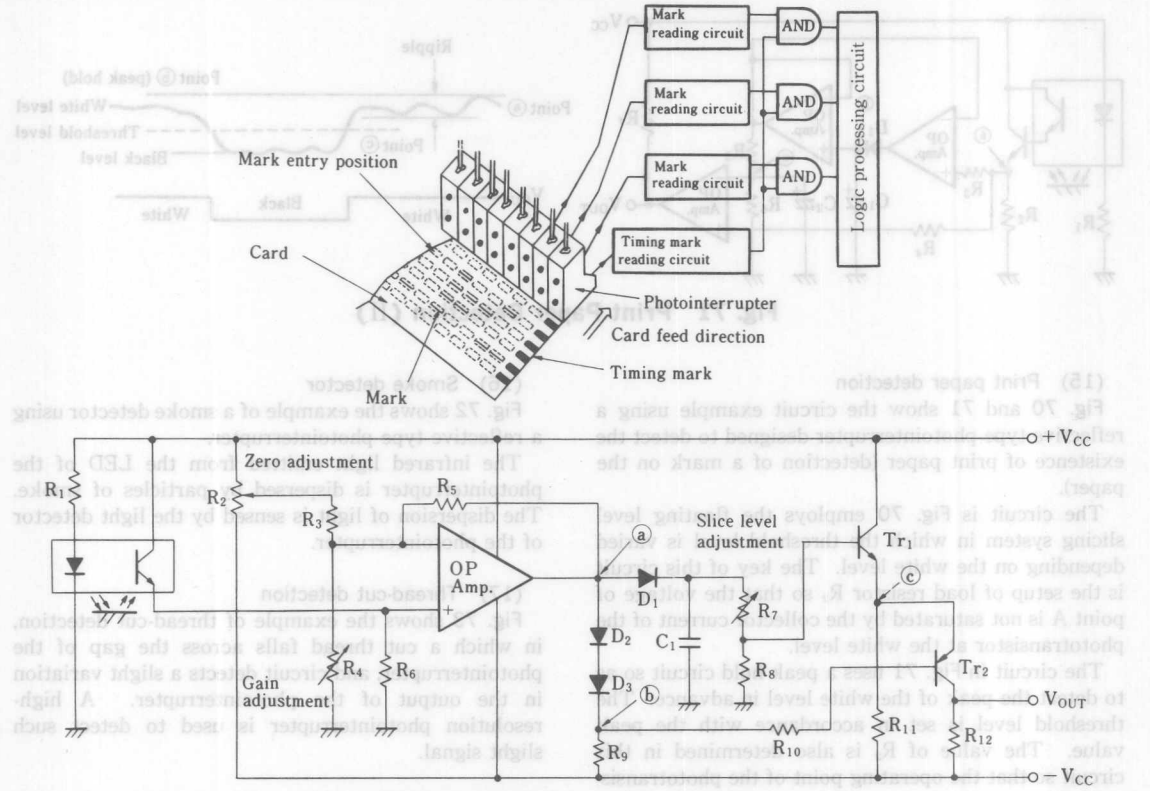


Fig. 67 Card Mark Reading Circuit

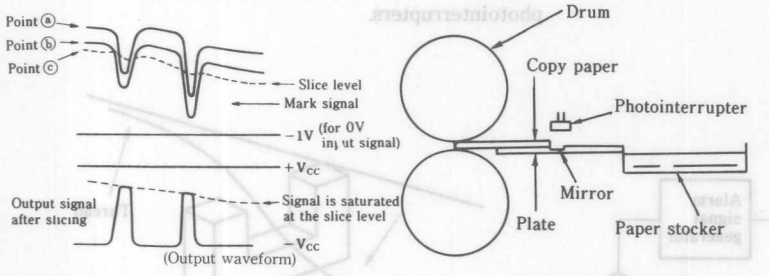


Fig. 68 Card Mark Detecting Signal

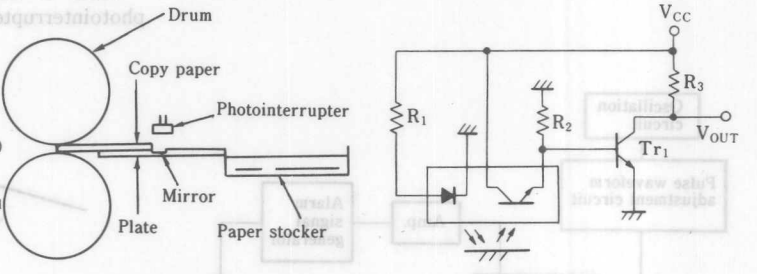


Fig. 69 Copy Paper Feed Detection in Copier

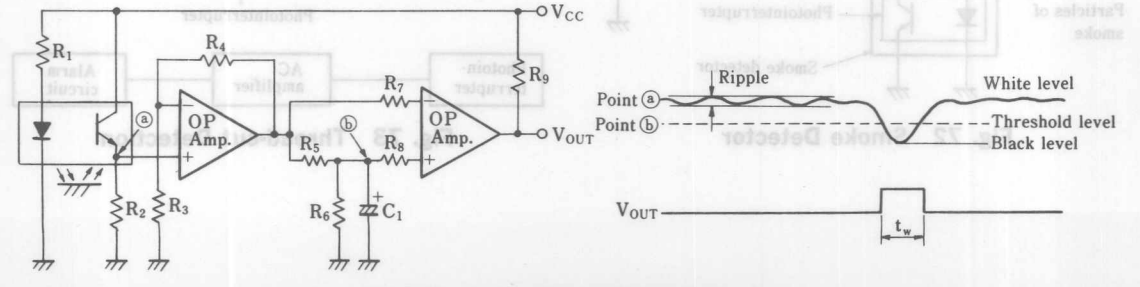


Fig. 70 Print Paper Detection (I)

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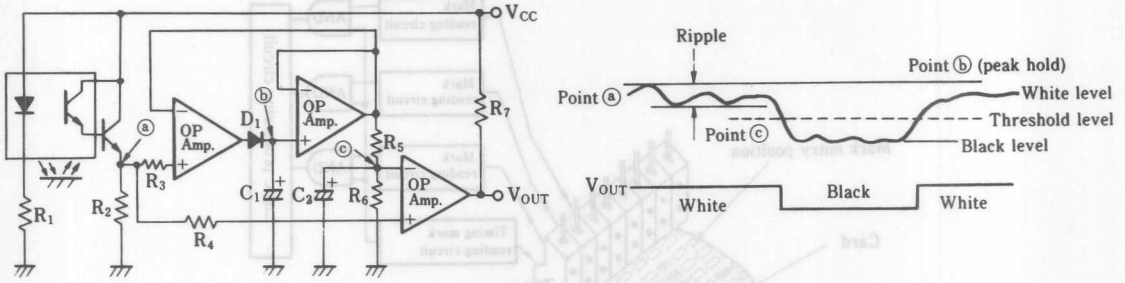


Fig. 71 Print Paper Detection (II)

(15) Print paper detection

Fig. 70 and 71 show the circuit example using a reflective type photointerrupter designed to detect the existence of print paper (detection of a mark on the paper).

The circuit is Fig. 70 employs the floating level slicing system in which the threshold level is varied depending on the white level. The key of this circuit is the setup of load resistor R_2 so that the voltage of point A is not saturated by the collector current of the phototransistor at the white level.

The circuit in Fig. 71 uses a peak hold circuit so as to detect the peak of the white level in advance. The threshold level is set in accordance with the peak value. The value of R_2 is also determined in this circuit so that the operating point of the phototransistor is not saturated.

(16) Smoke detector

Fig. 72 shows the example of a smoke detector using a reflective type photointerrupter.

The infrared light emitted from the LED of the photointerrupter is dispersed by particles of smoke. The dispersion of light is sensed by the light detector of the photointerrupter.

(17) Thread-cut detection

Fig. 73 shows the example of thread-cut detection, in which a cut thread falls across the gap of the photointerrupter, and circuit detects a slight variation in the output of the photointerrupter. A high-resolution photointerrupter is used to detect such slight signal.

(18) Photointerrupter application fields

Table 2 summarizes the application fields of photointerrupters.

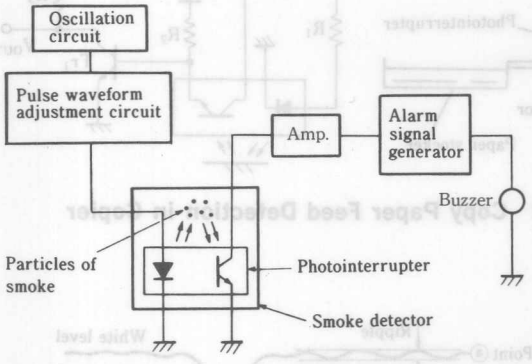


Fig. 72 Smoke Detector

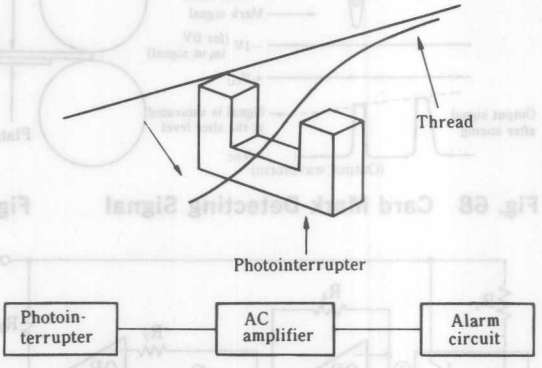


Fig. 73 Thread-cut Detection

Table 2 Photointerrupter application fields

Field		Equipment	Applications
A	Computer peripheral devices	Input/output units	Paper tape reader, punched card reader
		Magnetic disk unit	Head start position detection (heading)
			Disk write-protection notch detection (erasure prevention)
B	Measuring instruments	Industrial measuring instruments	Upper of panel meter/lower limit detection
			Counter circuit
		Electronic micrometer, caliper	Detection of the number of rotations, and rotational direction
		Electronic balances	Weight counter
		Water meters, gas meters	Flow meter
C	Office equipment	Copiers	Paper feed timing detection
			Paper feed direction detection
			Drum timing detection
			Toner quantity detection
		Facsimiles	Paper feed timing detection
			Paper passage detection
		Printers	Timing detection of print drum
			End detection of inked ribbon
			Timing detection of paper-out and paper feed
		ECRs	Bar code reading
D	Automobiles	Speedometers	Speed alarm, power steering, automatic doorlocks, auto-driving controls
E	Automatic vending machines Ticket vending machines		Coin passage detection
			Ticket paper detection
F	Home appliances	VCRs	End detection of magnetic tape
			Slack detection of magnetic tape
			Rotation control of tape reel
		Electronic sewing machines	Needle up/down position detection
			Thread-cut detection
			Lower thread quantity detection
			Pattern recognition
		Room heaters	Fuel quantity detection
G	Audio equipment	Record players	Rotational speed monitoring of turntable
			Disk size detection
			Tone arm angle detection
			Unrecorded portion detection
		Cassette tape recorders	Tape end detection/Auto-return position detection
			Counter circuit
H	Medical equipment	Pulse counter	Pulse detection
I	Communications equipment	Transceivers	Digital tuning circuits
J	Others	Fuel pumps	Automatic shut off devices
		Telephone responders	Tape end detection
		Smoke detectors	Smoke particle detection

10-5 Solid state relay application circuits

Solid state relays (SSR) have extensive applications, from industrial equipment to home appliances, including SSRs for triggering for activating high power thyristors and triacs and SSRs for power control for directly switching AC loads.

The following describes the fundamental circuit example of SSRs.

(1) Snubber circuit

Application of a voltage above the rating at the output side of SSR would result in a malfunction or even destruction of the device due to overcurrent. The snubber circuit is designed to absorb and suppress impulse noise.

Fig. 74 shows some examples of a snubber circuit.

Circuit (a) is most commonly used for CR absorbers.

Circuit (b) is more effective for noise absorption since it can have a smaller R_{S2} value.

Circuit (c) uses a varistor which can absorb high energy noise such as that caused by lightning.

The values of the resistors and capacitors in the snubber circuit depend on the kind of load and power capacity.

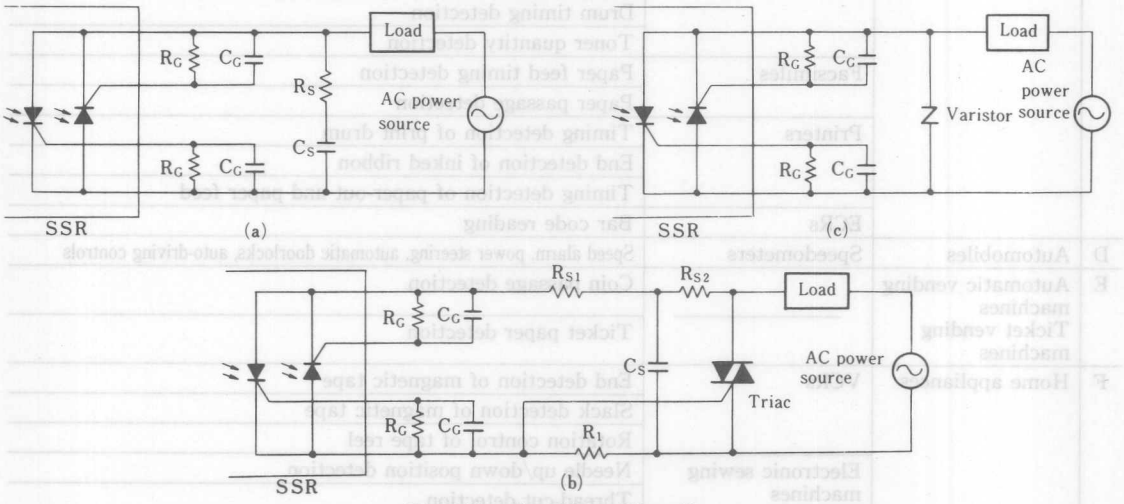


Fig. 74 Snubber Circuits

(2) Serial/parallel connections

Figs. 75 and 76 show the circuit of two SSRs connected in series and parallel, respectively. The following precautions should be considered when operating two photothyristors type SSRs connected in series or parallel.

For serial connections:

① Due to dispertion of leak current in forward and reverse of photothyristors, there can be a difference in the voltage across each device. For this reason, a resistor (R_1, R_2) is connected in parallel with each device so as to minimize the voltage difference.

② There are dispertion in the critical rate of rise of off-state voltage (dv/dt) among photothyristors depending on the junction capacity and sensitivity of devices. For this reason, the serial connection of resistor and capacitor (R_S, C_S) is connected in parallel to each device so that both SSRs are balanced.

For parallel connections:

① Two SSRs connected in parallel must be turned on simultaneously. if one SSR turns on first, the other SSR has both its terminals short-circuited through the first one and possibly cannot turn on even if the device has low on-voltage characteristics. For this reason, adjustments must be done through the gate resistor or gate capacitor so that both SSRs have an equal turn-on time.

② There are slight differences in the turn-on voltage according to devices. This causes an unbalanced current distribution among the photothyristors, resulting in the possibility of an overcurrent. On this account, a resistor of low resistance is connected serially to the photothyristor so as to adjust the on-voltage. This equalizes the current distribution in both devices.

(3) Zero-cross circuit

Fig. 77 shows a zero-cross circuit using photocouplers, As shown in waveforms A and B, both photocouplers are off around the zero voltage level of the AC power voltage. One of the photocouplers is on in the remaining time. Accordingly, a zero-detect signal can be produced by taking the logical product of signals A and B. A zero-cross made SSR is thus arranged through activation of the SSR by the zero-detect signal Q.

This system is particularly useful in operating multi-channel SSRs in a zero-cross mode in a programmable controller etc.

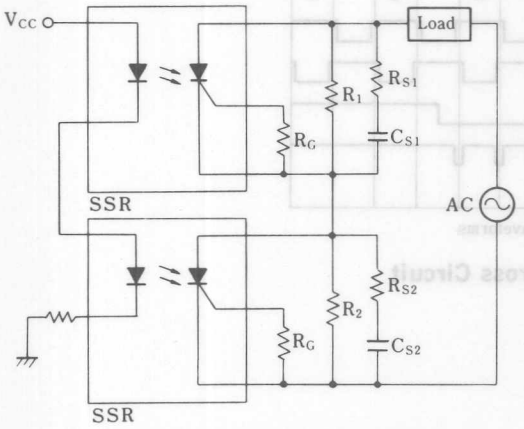


Fig. 75 Serial Connection Example

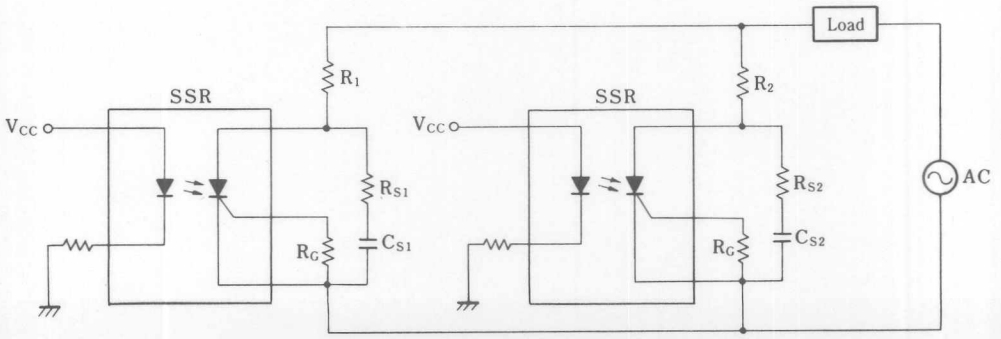
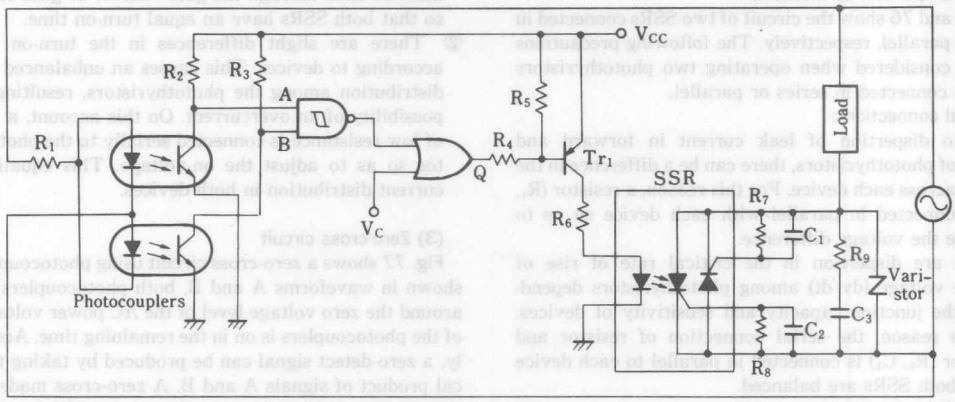
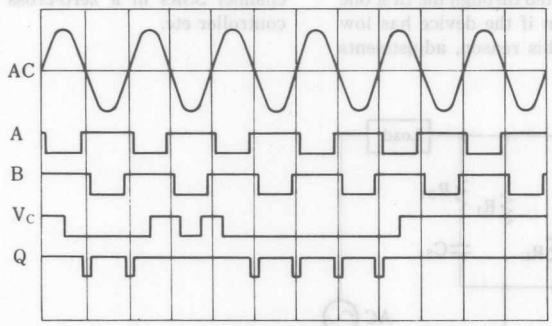


Fig. 76 Parallel Connection Example



(a) Zero-cross driving circuit



(b) Signal waveforms

Fig. 77 Zero-cross Circuit

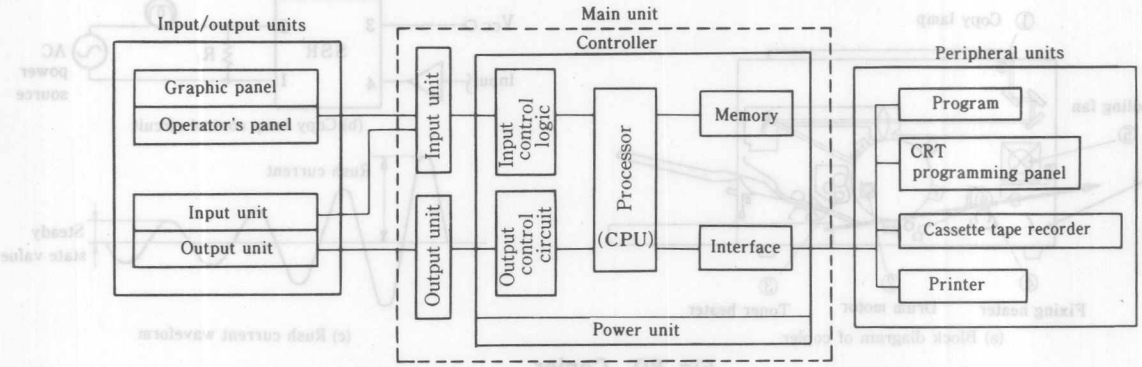


Fig. 78 Block Diagram of Programmable Controller

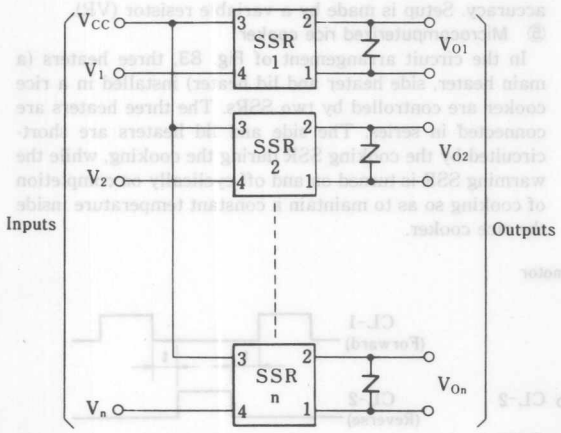


Fig. 79 Programmable Controller Output Unit

(4) Application circuits of SSR

① Programmable controller

A programmable controller is a sequence controller which takes the place of conventional relay sequence controllers. It consists of a CPU, memory, I/O interface and peripheral devices for programming. The input/output unit of the programmable controller employs photocouplers for the input post and photocouplers or SSRs for the output in place of conventional relay contacts.

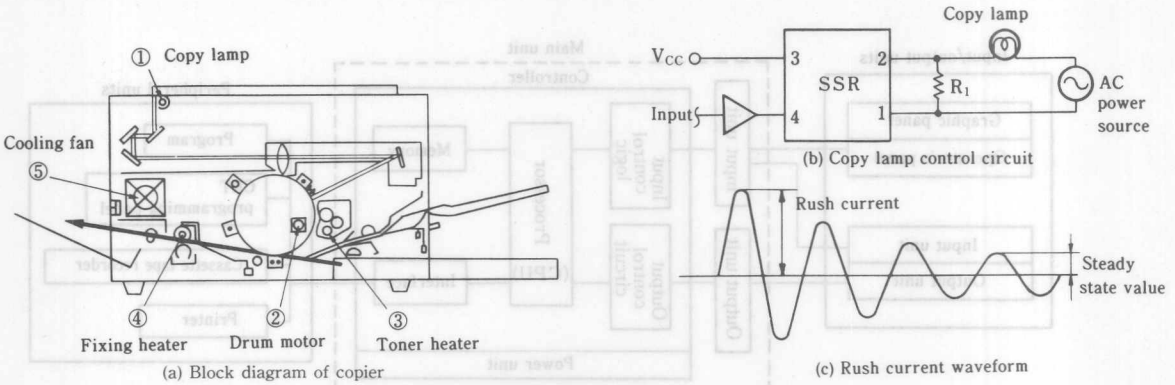
Fig. 78 is a block diagram of a typical programmable controller.

Fig. 79 shows the circuit of an output unit including 8 or 16 SSRs. The SIP-type SSR features a compact, built-in snubber circuit and input current limiting resistors and is frequently used in modern programmable controllers.

② Copier

Fig. 80 (a) shows an internal view of a copy machine in which SSRs are used. Fig. 80 (b) shows a circuit example of the copy lamp control circuit using SSRs.

The copy lamp has a start-up period of several power cycles in which a rush current 10 times or more than the steady-state current flows as shown in Fig. 80 (c), causing adverse effects on the peripheral circuit and lamp. In the control circuit of Fig. 80 (b), the SSR is shunted by resistor R_1 so as to supply a small current to the lamp for preheating. This reduces the rush current when starting.



(a) Block diagram of copier

(b) Copy lamp control circuit

(c) Rush current waveform

Fig. 80 Copier

③ Reversible motor driver

Fig. 81 (a) shows the circuit of a reversible motor driver using an SSR. The circuit operates in response to the input signal shown in Fig. 81 (b) to produce the motor current and voltage shown in Fig. 81 (c).

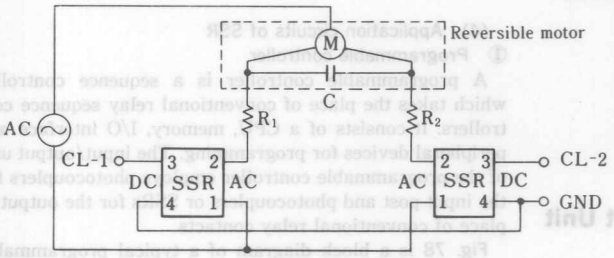
The reversible motor in driven in the forward or reverse direction by one of two SSRs. If both SSRs are made conductive simultaneously, the motor will overheat. To prevent this, a time length of 1/2 cycle or more is used in switching the rotational direction as shown in Fig. 81 (b). Each SSR is applied across its output terminals with a voltage twice the peak-to-peak voltage of the power line. Therefore, for a 100VAC power source, SSRs with a withstand voltage of 300V or more must be used.

④ Heater control circuit

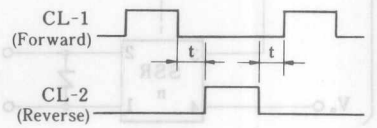
Fig. 82 shows a heater control circuit designed to maintain a constant temperature. A thermocoupler designed to (copper-constant) is used as a temperature sensor. An SSR is used to switch the power to the heater. The circuit shown features a wide temperature setting range and high control accuracy. Setup is made by a variable resistor (VR).

⑤ Microcomputerized rice cooker

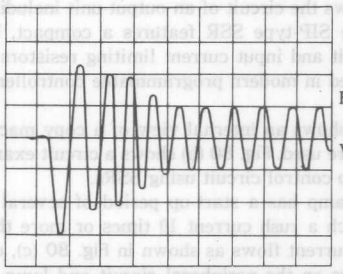
In the circuit arrangement of Fig. 83, three heaters (a main heater, side heater and lid heater) installed in a rice cooker are controlled by two SSRs. The three heaters are connected in series. The side and lid heaters are short-circuited by the cooking SSR during the cooking, while the warming SSR is turned on and off cyclically on completion of cooking so as to maintain a constant temperature inside the rice cooker.



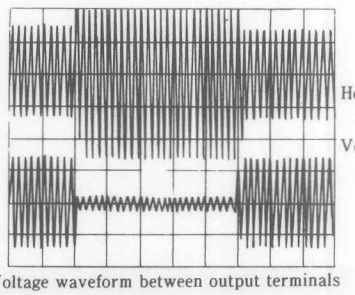
(a) Reversible motor driving circuit



(b) Timing chart



Motor current



Voltage waveform between output terminals

(c) Output waveforms

Fig. 81 Reversible Motor Driver

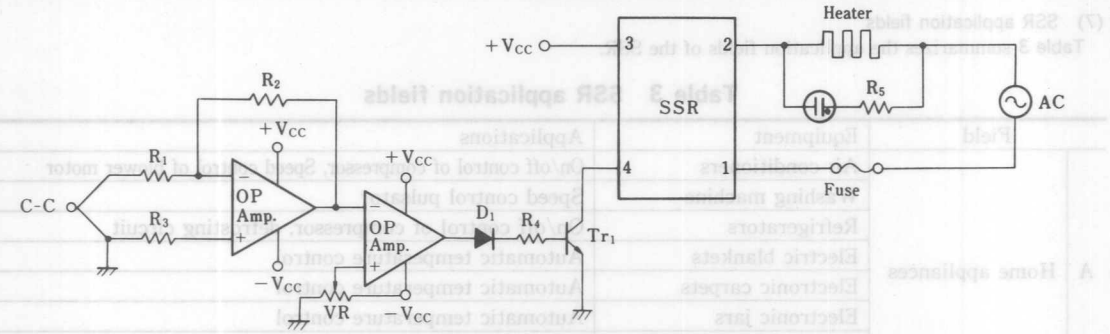


Fig. 82 Heater Control Circuit

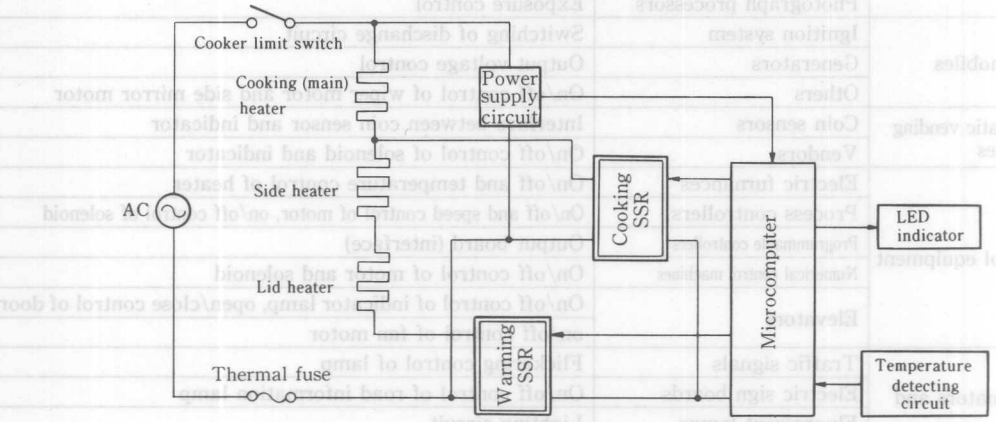


Fig. 83 Microcomputerized Cooker

10

(7) SSR application fields

Table 3 summarizes the application fields of the SSR.

Table 3 SSR application fields

Field		Equipment	Applications
A	Home appliances	Air-conditioners	On/off control of compressor, Speed control of blower motor
		Washing machine	Speed control pulsator
		Refrigerators	On/off control of compressor, defrosting circuit
		Electric blankets	Automatic temperature control
		Electronic carpets	Automatic temperature control
		Electronic jars	Automatic temperature control
		Electricpowered tools	Motor speed control
		Electric sewing machines	Motor speed control
B	Office equipment	Copiers	On/off control of copy lamp, heater control
		Facsimiles	Speed control of motor (drum)
		Computers	Power switching of peripheral equipment
		Printers	On/off and speed control of motor
		Photograph processors	Exposure control
C	Automobiles	Ignition system	Switching of dischange circuit
		Generators	Output voltage control
		Others	On/off control of wiper motor and side mirror motor
D	Automatic vending machines	Coin sensors	Interface between coin sensor and indicator
		Vendors	On/off control of solenoid and indicator
E	Control equipment	Electric furnances	On/off and temperature control of heater
		Process controllers	On/off and speed control of motor, on/off control of solenoid
		Programmable controllers	Output board (interface)
		Numerical control machines	On/off control of motor and solenoid
		Elevators	On/off control of indicator lamp, open/close control of door, on/off control of fan motor
F	Illuminators and others	Traffic signals	Flickering control of lamp
		Electric sign boards	On/off control of road information lamp
		Fluorescent lamps	Lighting circuit
		Illumination controllers	Phase control circuit

Table 1 Symbol and unit concerning illumination and irradiance (Reference)

Item	Symbol	Unit	Name of unit
Radiant flux	Φ, Φ_e, P	W	Watt
Luminous flux	Φ, Φ_v,	ℓm	Lumen
Emission efficiency	K	ℓm/W	Lumen/watt
Luminous efficiency	$K(\lambda)$	ℓm/W	Lumen/watt
Maximum luminous efficiency	K_m	ℓm/W	Lumen/watt
Spectral luminous efficiency	$V(\lambda)$	(Absolute number)	Lumen/watt
Efficiency of light source	η	ℓm/W	Lumen/watt
Quantity of light	Q, Q_v	ℓm-s	Lumen second
Illuminance	E, E_v	ℓx	Lux
Luminous exittance	M, M_v	ℓm/m²	Lumen/m²
Luminous intensity	I, I_v	cd	candela
Luminance	L, L_v	cd/m²	candela/m
Absorption ratio	α	(Absolute number)	
Reflectance	ρ	(Absolute number)	
Transmittance	τ	(Absolute number)	
Velocity of light in a vacuum	c	m/s	Meter/second
Wavelength	λ	m	Meter
Frequency, oscillation frequency	f, ν	Hz	Hertz
Refractive index	n	(Absolute number)	
Inverse number of dispersion	ν		
Absorption coefficient	a	m^{-1}	/meter
Extinction coefficient	α	m^{-1}	/meter
Scattering coefficient	σ	m^{-1}	/meter
Extinguishment coefficient	μ	m^{-1}	/meter
Absorption index	$\varkappa$	(Absolute number)	
Mol absorption index	$\varkappa$	m²/mol	m²/mol
Mol extinction index	ε	ℓ/(mol·cm)	Liter/(mol·cm)
Object distance	a	m	Meter
Image distance	b	m	Meter
Focal distance	f	m	Meter
Refractive index, (degree of lens)	D	Dptr	Dioptry
Magnification	m	(Absolute number)	
Radiant intensity	I, I_e	W/sr	Watt/stradian
Irradiance	E, E_e	W/m²	Watt/cm²
Radiance	L, L_e	W/(sr·m²)	Watt/(stradian·m²)

■ Values concerning illumination (Reference)

- Color temperature
  - CIE standard light source A 2856 〔°K〕
  - CIE standard light source A 4874 〔°K〕
  - CIE standard light source A 6774 〔°K〕
- Velocity of ligit
  - (In the air) 2.997×10^8 〔m/s〕
  - (In water) 2.249×10^8 〔m/s〕

Fig. 1 Spectral luminous efficiency curve

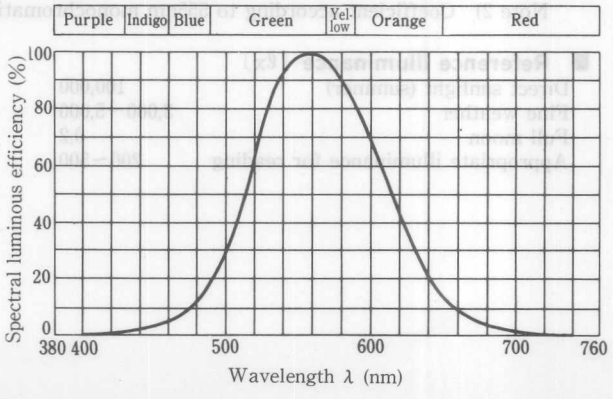


Table 2 Unit conversion table of luminance

A \ B	Candela/m² (nit)	Candela/m² (stilb)	Candela/ft²	Candela/in²	Apostilb	Lambert	Milli Lambert	Foot Lambert
A	cd/m²(nt)	cd/cm²(sb)	cd/ft²	cd/in²	asb	L	mL	fL
cd/m²(nt)	1	1.000×10^{-4}	9.290×10^{-2}	6.452×10^{-4}	3.142	3.142×10^{-4}	3.142×10^{-1}	2.919×10^{-1}
cd/cm²(sb)	1.000×10^{4}	1	9.290×10^{2}	6.452	3.142×10^{4}	3.142	3.142×10^{3}	2.919×10^{3}
cd/ft²	1.076×10^{1}	1.076×10^{-3}	1	6.944×10^{-3}	3.382×10^{1}	3.382×10^{-3}	3.382	3.142
cd/in²	1.550×10^{3}	1.550×10^{-1}	1.440×10^{2}	1	4.870×10^{3}	4.870×10^{-1}	4.870×10^{2}	4.524×10^{2}
asb	3.183×10^{-1}	3.183×10^{-5}	2.957×10^{-2}	2.054×10^{-4}	1	1.000×10^{-4}	1.000×10^{-1}	9.290×10^{-2}
L	3.183×10^{3}	3.183×10^{-1}	2.957×10^{2}	2.054	1.000×10^{4}	1	1.000×10^{3}	9.290×10^{2}
mL	3.183	3.183×10^{-4}	2.957×10^{-1}	2.054×10^{-3}	1.000×10^{1}	1.000×10^{-3}	1	9.290×10^{-1}
fL	3.426	3.426×10^{-4}	3.183×10^{-1}	2.210×10^{-3}	1.076×10^{1}	1.076×10^{-3}	1.076	1

Remarks: A (unit)×coefficient=B (unit)
Example: $15cd/m^2=15\times10^{-4}sb$
$20fL=20\times1.076\times10^{1}asb=215asb$

■ Reference luminance (cd/cm²)

- Sun (at the zenith) 160,000
- Sun (on the horizon) 600
- Lunar surface 0.2
- Fluorescent lamp 0.35
- Candlelight 0.5

Table 3 Unit conversion table of illumination

A \ B		Lux (lumen/m²)	Photo (lumen/cm²)	Foot candle (lumen/ft²)	Note 1) Watt/cm²	Note 2) Watt/cm²
A		ℓx(ℓm/m²)	ph(ℓm/cm²)	fc(ℓm/ft²)	W/cm²	W/cm²
ℓx	(ℓm/m²)	1	1.000×10^{-4}	9.290×10^{-2}	5.21×10^{-6}	1.47×10^{-7}
ph	(ℓm/cm²)	1.000×10^{4}	1	9.290×10^{2}	5.21×10^{-2}	1.47×10^{-3}
fc	(ℓm/ft²)	1.076×10^{1}	1.076×10^{-3}	1	5.62×10^{-5}	1.58×10^{-6}
Note 1)(W/cm²)		1.92×10^{5}	1.92×10^{1}	1.78×10^{4}	1	—
Note 2)(W/cm²)		6.80×10^{6}	6.80×10^{2}	6.32×10^{5}	—	1

Remarks: A (unit)×conversion coefficient=B (unit)
Example: $15\ell x=15\times10^{-4}ph$
$20fc=20\times1.076\times10^{1}\ell x=215\ell x$
Note 1) Total radiant illuminance according to CIE standard light source A (conversion coefficient is actual value)
Note 2) Coefficient according to 555nm monochromatic light

■ Reference illuminance (ℓx)

Direct sunlight (summer)	100,000
Fine weather	3,000～5,000
Full moon	0.2
Appropriate illuminance for reading	200～500

PHOTOCOUPLER CROSS REFERENCE

For user's convenience, the Sharp equivalents in comparison with the other manufacturers' products are suggested in this list.

The data is prepared on the basis of main electrical and mechanical characteristics, however, Sharp assumes no responsibility for the actual use of the data and for the specifications of other manufacturers' products.

The pertinent Sharp product specification sheet should be referred to in actual replacement.

INDEX

MANUFACTURERS

GENERAL ELECTRIC (GE) ····· P842
GENERAL INSTRUMENT (GI) ····· P853
HEWLETT PACKARD (HP) ····· P864
MOTOROLA (MO) ····· P865
SIEMENS (SI) ····· P874
TOSHIBA (TO) ····· P884

※ The classification between "Direct replacement", "Similar" and "Different" is based on the following main electrical and mechanical characteristics.

Electrical : I_F, V_{CEO}, V_{iso}, P_C, CTR

Mechanical : Pin configuration, Package shape

Symbol

I_F : Forward current
V_{CEO} : Collector-emitter voltage
V_{iso} : Isolation voltage
P_C : Collector power dissipation (Output)
CTR : Current transfer ratio
V_{DRM} : Repetitive peak off-state voltage
I_{FT} : Minimum trigger current

GENERAL ELECTRIC VS. SHARP

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
4N25	PC4N25V			
4N25A	PC4N25V			V_{iso} : SC (2,500Vrms), GE (1,775Vrms, 1sec)
4N26	PC4N26V			
4N27	PC4N27V			
4N28	PC4N28V			
4N29	PC4N29V			
4N29A	PC4N29V			V_{iso} : SC (2,500Vrms), GE (1,775Vrms, 1sec)
4N30	PC4N30V			
4N31	PC4N30V			CTR : SC (100%), GE (50%)
4N32	PC4N32V			
4N32A	PC4N32V			V_{iso} : SC (2,500Vrms), GE (1,775Vrms, 1sec)
4N33	PC4N33V			
4N35	PC4N35V			
4N36	PC4N36V			
4N37	PC4N37V			
4N38	PC702V	S		I_F : SC (60mA), GE (80mA) V_{CEO} : SC (70V), GE (80V) V_{iso} : SC (5,000Vrms), GE (1,500Vpeak) P_C : SC (160mW), GE (150mW) CTR : Mesurement condition
4N38A	PC702V	S		I_F : SC (60mA), GE (80mA) V_{CEO} : SC (70V), GE (80V) V_{iso} : SC (5,000Vrms), GE (1,775Vrms, 1sec) P_C : SC (160mW), GE (150mW) CTR : Mesurement condition
4N39	S12MD1V	S		I_F : SC (50mA), GE (60mA) V_{DRM} : SC (400V), GE (200V) V_{iso} : SC (5,000Vrms), GE (1,060Vrms) I_{FT} : Measurement condition
4N40	S12MD1V	S		I_F : SC (50mA), GE (60mA) V_{iso} : SC (5,000Vrms), GE (1,060Vrms) I_{FT} : Measurement condition
CNY17-1	PC702VA	S		I_F : SC (60mA), GE (100mA) P_C : SC (160mW), GE (150mW)
CNY17-2	PC702VB	S		I_F : SC (60mA), GE (100mA)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				P_C : SC (160mW), GE (150mW)
CNY17-3	PC702VC	S		I_F : SC (60mA), GE (100mA)
				P_C : SC (160mW), GE (150mW)
CNY17-4	PC702VD	S		I_F : SC (60mA), GE (100mA)
				P_C : SC (160mW), GE (150mW)
CNY30	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (200V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				I_{FT} : Measurement condition
CNY32	PC511	S	D	I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				P_C : SC (75mW), GE (100mW)
				CTR : Measurement condition
				Package : Size
CNY33	PC851	S	D	I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (300V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
				Package : SC (4pin), GE (6pin)
CNY34	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				I_{FT} : Measurement condition
CNY35	PC733	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,060Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
CNY47	PC713V			I_F : SC (50mA), GE (30mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (2,000Vrms)
				CTR : Measurement condition
CNY47A	PC713V			I_F : SC (50mA), GE (30mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (2,000Vrms)
				CTR : Measurement condition
CNY48	PC4N32V			I_F : SC (80mA), GE (60mA)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (2,500Vrms), GE (1,500Vrms)
				CTR : Measurement condition
CNY51	PC702V	S		P_C : SC (160mW), GE (300mW)
				CTR : Measurement condition
GE3009	S11MD5V			V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
GE3010	S11MD5V			V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
GE3011	S11MD5V			V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
GE3012	S11MD5V			V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
GE3020	S11MD5V			V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
GE3021	S11MD5V			V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
GE3022	S11MD5V			V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
GE3023	S11MD5V			V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
GFH600-1	PC702VB	S		V_{iso} : SC (5,000Vrms), GE (2,800Vrms)
				P : SC (105mW), GE (150mW)
GFH600-2	PC702VC	S		V_{iso} : SC (5,000Vrms), GE (2,800Vrms)
				P : SC (105mW), GE (150mW)
GFH600-3	PC702VD	S		V_{iso} : SC (5,000Vrms), GE (2,800Vrms)
				P : SC (105mW), GE (150mW)
GFH601-1	PC702VA	S		V_{iso} : SC (5,000Vrms), GE (3,750Vrms)
				P : SC (105mW), GE (150mW)
GFH601-2	PC702VB	S		V_{iso} : SC (5,000Vrms), GE (3,750Vrms)
				P : SC (105mW), GE (150mW)
GFH601-3	PC702VC	S		V_{iso} : SC (5,000Vrms), GE (3,750Vrms)
				P : SC (105mW), GE (150mW)
GFH601-4	PC702VD	S		V_{iso} : SC (5,000Vrms), GE (3,750Vrms)
				P : SC (105mW), GE (150mW)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
GEPS2001	PC713V	S		I_F : SC (50mA), GE (60mA) V_{CEO} : SC (35V), GE (30V) V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
H11A1	PC713V	S		I_F : SC (50mA), GE (60mA) V_{CEO} : SC (35V), GE (30V) V_{iso} : SC (5,000Vrms), GE (1,770Vrms) CTR : Measurement condition
H11A10	PC713V	S		V_{CEO} : SC (35V), GE (30V) P_C : SC (150mW), GE (300mW) V_{iso} : SC (5,000Vrms), GE (1,060Vrms) CTR : Measurement condition
H11A2	PC713V	S		I_F : SC (50mA), GE (60mA) V_{CEO} : SC (35V), GE (30V) V_{iso} : SC (5,000Vrms), GE (1,060Vrms) CTR : Measurement condition
H11A3	PC713V	S		I_F : SC (50mA), GE (60mA) V_{CEO} : SC (35V), GE (30V) V_{iso} : SC (5,000Vrms), GE (1,770Vrms) CTR : Measurement condition
H11A4	PC713V	S		I_F : SC (50mA), GE (60mA) V_{CEO} : SC (35V), GE (30V) V_{iso} : SC (5,000Vrms), GE (1,060Vrms) CTR : Measurement condition
H11A5	PC713V	S		I_F : SC (50mA), GE (60mA) V_{CEO} : SC (35V), GE (30V) V_{iso} : SC (5,000Vrms), GE (1,060Vrms) CTR : Measurement condition
H11A520	PC702V	S		V_{CEO} : SC (70V), GE (30V) V_{iso} : SC (5,000Vrms), GE (4,000Vrms) P_C : SC (160mW), GE (300mW) CTR : Measurement condition
H11A550	PC702V	S		V_{CEO} : SC (70V), GE (30V) V_{iso} : SC (5,000Vrms), GE (4,000Vrms) P_C : SC (160mW), GE (300mW) CTR : Measurement condition
H11A5100	PC702V	S		V_{CEO} : SC (70V), GE (30V) V_{iso} : SC (5,000Vrms), GE (4,000Vrms)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				P_C : SC (160mW), GE (300mW)
				CTR : Measurement condition
H11AA1	PC733	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
H11AA2	PC733	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
H11AA3	PC733	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
H11AA4	PC733	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
H11AG1	PC713V			V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				CTR : Measurement condition
H11AG2	PC713V			V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				CTR : Measurement condition
H11AG3	PC713V			V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				CTR : Measurement condition
H11AV1	PC112	S	D	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				P_C : SC (160mW), GE (300mW)
				CTR : Measurement condition
				Internal isolation distance :
				SC (0.5mm), GE (2mm)
				Lead frame width

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GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
H11AV1A	PC112	S	S	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				P_C : SC (160mW), GE (300mW)
				CTR : Measurement condition
				Internal isolation distance :
				SC (0.5mm), GE (2mm)
H11AV2	PC112	S	D	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				P_C : SC (160mW), GE (300mW)
				CTR : Measurement condition
				Internal isolation distance :
				SC (0.5mm), GE (2mm)
				Lead frame width
H11AV2A	PC112	S	S	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				P_C : SC (160mW), GE (300mW)
				CTR : Measurement condition
				Internal isolation distance :
				SC (0.5mm), GE (2mm)
H11AV3	PC112	S	D	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				P_C : SC (160mW), GE (300mW)
				CTR : Measurement condition
				Internal isolation distance :
				SC (0.5mm), GE (2mm)
				Lead frame width
H11AV3A	PC112	S	S	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				P_C : SC (160mW), GE (300mW)
				CTR : Measurement condition
				Internal isolation distance :
				SC (0.5mm), GE (2mm)
H11B1	PC4N32V			I_F : SC (80mA), GE (60mA)
				V_{CEO} : SC (30V), GE (25V)
				V_{iso} : SC (2,500Vrms), GE (1,770Vrms)
				CTR : Measurement condition
H11B2	PC4N32V			I_F : SC (80mA), GE (60mA)
				V_{CEO} : SC (30V), GE (25V)

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E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (2,500Vrms), GE (1,770Vrms)
				CTR : Measurement condition
H11B255	PC4N32V	S		I_F : SC (80mA), GE (60mA)
				V_{CEO} : SC (30V), GE (55V)
				V_{iso} : SC (2,500Vrms), GE (1,060Vrms)
				P_C : SC (150mW), GE (210mW)
				CTR : Measurement condition
H11B3	PC4N32V			I_F : SC (80mA), GE (60mA)
				V_{CEO} : SC (30V), GE (25V)
				V_{iso} : SC (2,500Vrms), GE (1,770Vrms)
				CTR : Measurement condition
H11C1	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (200V)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				I_{FT} : Measurement condition
H11C2	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (200V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				I_{FT} : Measurement condition
H11C3	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (200V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				I_{FT} : Measurement condition
H11C4	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				I_{FT} : Measurement condition
H11C5	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				I_{FT} : Measurement condition
H11C6	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				I_{FT} : Measurement condition
H11D1	PC851	S	D	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
				Package : SC (4pin), GE (6pin)
H11D2	PC851	S	D	I_F : SC (50mA), GE (60mA)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				P_C : SC(150mW), GE (300mW)
				CTR : Measurement condition
				Package : SC (4pin), GE (6pin)
H11D3	PC851	S	D	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
				Package : SC (4pin), GE (6pin)
H11D4	PC851	S	D	I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				P_C : SC (150mW), GE (300mW)
				CTR : Measurement condition
				Package : SC (4pin), GE (6pin)
H11F1	PC619			V_{iso} : SC (2,000Vrms), GE (1,770Vrms)
H11F2	PC619	S		V_{iso} : SC (2,000Vrms), GE (1,770Vrms)
				R_{on} (MAX.) : SC (200Ω), GE (330Ω)
H11F3	PC619	S		V_{BR} : SC (30V), GE (15V)
				V_{iso} : SC (2,000Vrms), GE (1,060Vrms)
				R_{on} (MAX.) : SC (200Ω), GE (470Ω)
H11G1	PC725V	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (300V), GE (100V)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				P_C : SC (300mW), GE (150mW)
				CTR : Measurement condition
H11G2	PC725V	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (300V), GE (80V)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				P_C : SC (300mW), GE (150mW)
				CTR : Measurement condition
H11G3	PC725V	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (300V), GE (55V)
				V_{iso} : SC (5,000Vrms), GE (1,500Vrms)
				P_C : SC (300mW), GE (150mW)
				CTR : Measurement condition
H11G45	PC725V	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (300V), GE (55V)
				V_{iso} : SC (5,000Vrms) , GE (4,000Vrms)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				P_C : SC (300mW), GE (150mW)
				CTR : Measurement condition
H11G46	PC725V	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (300V), GE (55V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				P_C : SC (300mW), GE (150mW)
				CTR : Measurement condition
H11J1	S11MD5V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
H11J2	S11MD5V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (4,000Vrms)
				I_{FT} : Measurement condition
H11J3	S11MD5V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				I_{FT} : Measurement condition
H11J4	S11MD5V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				I_{FT} : Measurement condition
H11J5	S11MD5V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (250V)
				V_{iso} : SC (5,000Vrms), GE (1,500Vrms)
				I_{FT} : Measurement condition
H11L1	PC900V	S		I_F : SC (50mA), GE (60mA)
				I_F (on)(MAX.) : SC (4mA : R_L=280Ω), GE (1.6mA : R_L=270Ω)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				t_{PHL} : Measurement condition
H11L2	PC900V	S		I_F : SC (50mA), GE (60mA)
				I_F (on)(MAX.) : SC (4mA : R_L=280Ω), GE (10mA : R_L=270Ω)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				t_{PHL} : Measurement condition
H11L3	PC900V	S		I_F : SC (50mA), GE (60mA)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				I_F (on)(MAX.) : SC (4mA : $R_L = 280\Omega$), GE (5.0mA : $R_L = 270\Omega$)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				t_{PHL} : Measurement condition
H24A1	PC511	S	D	I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (4,242Vrms)
				P_C : SC (75mW), GE (150mW)
				CTR : Measurement condition
				Package : Size
H24A2	PC511	S	D	I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (4,242Vrms)
				P_C : SC (75mW), GE (150mW)
				CTR : Measurement condition
				Package : Size
H74C1	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (200V)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				I_{FT} : Measurement condition
H74C2	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (1,770Vrms)
				I_{FT} : Measurement condition
MCA230	PC4N32V	S		I_F : SC (80mA), GE (60mA)
				P_C : SC (150mW), GE (210mW)
				CTR : Measurement condition
MCA231	PC4N32V	S		I_F : SC (80mA), GE (60mA)
				P_C : SC (150mW), GE (210mW)
				CTR : Measurement condition
MCA255	PC4N32V	S		I_F : SC (80mA), GE (60mA)
				P_C : SC (150mW), GE (210mW)
				CTR : Measurement condition
MCS2	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (200V)
				V_{iso} : SC (5,000Vrms), GE (2,550Vrms)
				I_{FT} : Measurement condition
MCS21	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{DRM} : SC (400V), GE (200V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GE MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), GE (3,000Vrms)
				I_{FT} : Measurement condition
MCS2400	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (2,550Vrms)
				I_{FT} : Measurement condition
MCS2401	S12MD1V	S		I_F : SC (50mA), GE (60mA)
				V_{iso} : SC (5,000Vrms), GE (3,000Vrms)
				I_{FT} : Measurement condition
MCT2	PC713V	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,060Vrms)
				P_C : SC (150mW), GE (200mW)
				CTR : Measurement condition
MCT210	PC702VD			V_{CEO} : SC (70V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,500Vrms)
				P_C : SC (160mW), GE (200mW)
MCT26	PC713V	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (1,060Vrms)
				P_C : SC (150mW), GE (200mW)
				CTR : Measurement condition
MCT2E	PC713V	S		I_F : SC (50mA), GE (60mA)
				V_{CEO} : SC (35V), GE (30V)
				V_{iso} : SC (5,000Vrms), GE (2,500Vrms)
				P_C : SC (150mW), GE (200mW)
				CTR : Measurement condition

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

GENERAL INSTRUMENT VS. SHARP

E : Electrical
M : Mechanical

GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
4N25	PC4N25V			
4N26	PC4N26V			
4N27	PC4N27V			
4N28	PC4N28V			
4N29	PC4N29V			
4N30	PC4N30V			
4N31	PC4N30V	S		V_{iso} : SC (1,500Vrms), GI (2,500Vrms)
				CTR : Measurement condition
4N32	PC4N32V			
4N33	PC4N33V			
4N35	PC4N35V			
4N36	PC4N36V			
4N37	PC4N37V			
6N135	6N135	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
6N136	6N136	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
6N137	6N137	S		CM_H (TYP.) : SC (500V/μs), GI (10kV/μs)
6N138	6N138	S		CM_H (TYP.) : SC (500V/μs), GI (10kV/μs)
6N139	6N139	S		CM_H (TYP.) : SC (500V/μs), GI (10kV/μs)
CNX35	PC702V	S		I_F : SC (60mA), GI (100mA)
				V_{CEO} : SC (70V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (3,734Vrms)
				P_C : SC (160mW), GI (150mW)
				CTR : Measurement condition
CNX36	PC702V	S		I_F : SC (60mA), GI (100mA)
				V_{CEO} : SC (70V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (3,734Vrms)
				P_C : SC (160mW), GI (150mW)
				CTR : Measurement condition
CNY17-1	PC702VA	S		I_F : SC (60mA), GI (90mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
CNY17-1Z	PC702VA	S		I_F : SC (60mA), GI (90mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
CNY17-2	PC702VB	S		I_F : SC (60mA), GI (90mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
CNY17-2Z	PC702VB	S		I_F : SC (60mA), GI (90mA)

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
CNY17-3	PC702VC	S		I_F : SC (60mA), GI (90mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
CNY17-3Z	PC702VC	S		I_F : SC (60mA), GI (90mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
CNY17-4	PC702VD	S		I_F : SC (60mA), GI (90mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
CNY17-4Z	PC702VD	S		I_F : SC (60mA), GI (90mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
H11A1	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : Measurement condition
H11A1Z	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : Measurement condition
H11A2	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : Measurement condition
H11A2Z	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : Measurement condition
H11A3	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : Measurement condition
H11A3Z	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : Measurement condition
H11AA1	PC733	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (300mW)
				CTR : Measurement condition

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				I_F: SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (300mW)
				CTR : Measurement condition
H11AA3	PC733	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (300mW)
				CTR : Measurement condition
H11AA4	PC733	S		I_F : SC(50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (30V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (300mW)
				CTR : Measurement condition
H11B1	PC4N32V			I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (25V)
				CTR : Measurement condition
H11B1Z	PC4N32V			I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (25V)
				CTR : Measurement condition
H11B2	PC4N32V			I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (25V)
				CTR : Measurement condition
H11B2Z	PC4N32V			I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (25V)
				CTR : Measurement condition
H11B3	PC4N32V			I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (25V)
				CTR : Measurement condition
H11B3Z	PC4N32V			I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (25V)
				CTR : Measurement condition
H11D1	PC851	S	D	I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms, 5sec.)
				P_C : SC (150mW), GI (300mW)
				CTR : Measurement condition
				Package : SC (4pin), GI (6pin)

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
H11D1Z	PC851	S	D	I_F : SC (50mA), GI (60mA) V_{iso} : SC (5,000Vrms), GI (5,300Vrms, 5sec.) P_C : SC (150mW), GI (300mW) CTR : Measurement condition Package : SC (4pin), GI (6pin)
H11D2	PC851	S	D	I_F : SC (50mA), GI (60mA) V_{iso} : SC (5,000Vrms), GI (5,300Vrms, 5sec.) P_C : SC (150mW), GI (300mW) CTR : Measurement condition Package : SC (4pin), GI (6pin)
H11D2Z	PC851	S	D	I_F : SC (50mA), GI (60mA) V_{iso} : SC (5,000Vrms), GI (5,300Vrms, 5sec.) P_C : SC (150mW), GI (300mW) CTR : Measurement condition Package : SC (4pin), GI (6pin)
H11D3	PC851	S	D	I_F : SC (50mA), GI (60mA) V_{CEO} : SC (300V), GI (200V) V_{iso} : SC (5,000Vrms), GI (5,300Vrms, 5sec.) P_C : SC (150mW), GI (300mW) CTR : Measurement condition Package : SC (4pin), GI (6pin)
H11D3Z	PC851	S	D	I_F : SC (50mA), GI (60mA) V_{CEO} : SC (300V), GI (200V) V_{iso} : SC (5,000Vrms), GI (5,300Vrms, 5sec.) P_C : SC (150mW), GI (300mW) CTR : Measurement condition Package : SC (4pin), GI (6pin)
H11G1	PC725V	S		I_F : SC (50mA), GI (60mA) V_{CEO} : SC (300V), GI (100V) V_{iso} : SC (5,000Vrms), GI (2,500Vrms) P_C : SC (300mW), GI (200mW) CTR : Measurement condition
H11G2	PC725V	S		I_F : SC (50mA), GI (60mA) V_{CEO} : SC (300V), GI (80V) V_{iso} : SC (5,000Vrms), GI (2,500Vrms) P_C : SC (300mW), GI (200mW) CTR : Measurement condition
H11G3	PC725V	S		I_F : SC (50mA), GI (60mA)

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{CEO} : SC (300V), GI (55V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (300mW), GI (200mW)
				CTR : Measurement condition
HCPL2502	6N136	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
HCPL2503	6N136	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
HCPL2530	PC9D17	S		P_C : SC (100mW), GI (35mW)
				CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
HCPL2531	PC9D17	S		P_C : SC (100mW), GI (35mW)
				CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
HCPL2601	6N137	S		P_C : SC (85mW), GI (40mW)
				CM_H (TYP.) : SC (500V/μs), GI (10kV/μs)
HCPL2630	PC9D10	S		I_F (1ch) : SC (15mA), GI (30mA)
				CM_H (TYP.) : SC (500V/μs), GI (10kV/μs)
MCA11G1	PC725V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (300V), GI (100V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (300mW), GI (200mW)
				CTR : Measurement condition
MCA11G2	PC725V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (300V), GI (80V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (300mW), GI (200mW)
				CTR : Measurement condition
MCA11G3	PC725V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (300V), GI (55V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (300mW), GI (200mW)
				CTR : Measurement condition
MCA230	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				P_C : SC (150mW), GI (210mW)
				CTR : Measurement condition
MCA231	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				P_C : SC (150mW), GI (210mW)
				CTR : Measurement condition
MCA255	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (55V)
				P_C : SC (150mW), GI (210mW)

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				CTR : Measurement condition
MCA2230	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				V_{iso} : SC (2,500Vrms), GI (5,300Vrms)
				P_C : SC (150mW), GI (210mW)
				CTR : Measurement condition
MCA2230Z	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				V_{iso} : SC (2,500Vrms), GI (5,300Vrms)
				P_C : SC (150mW), GI (210mW)
				CTR : Measurement condition
MCA2231	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				V_{iso} : SC (2,500Vrms), GI (5,300Vrms)
				P_C : SC (150mW), GI (210mW)
				CTR : Measurement condition
MCA2231Z	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				V_{iso} : SC (2,500Vrms), GI (5,300Vrms)
				P_C : SC (150mW), GI (210mW)
				CTR : Measurement condition
MCA2255	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (55V)
				V_{iso} : SC (2,500Vrms), GI (5,300Vrms)
				P_C : SC (150mW), GI (210mW)
				CTR : Measurement condition
MCA2255Z	PC4N32V	S		I_F : SC (80mA), GI (60mA)
				V_{CEO} : SC (30V), GI (55V)
				V_{iso} : SC (2,500Vrms), GI (5,300Vrms)
				P_C : SC (150mW), GI (210mW)
				CTR : Measurement condition
MCL2501	6N136	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
MCL2502	6N136	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
MCL2503	6N136	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
MCL2530	PC9D17	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
MCL2531	PC9D17	S		CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
MCL2601	6N137	S		P_C : SC (85mW), GI (40mW)
				CM_H (TYP.) : SC (1kV/μs), GI (10kV/μs)
MCL2630	PC9D10	S		CM_H (TYP.) : SC (500V/μs), GI (10kV/μs)
MCL2631	PC9D10	S		CM_H (TYP.) : SC (500V/μs), GI (10kV/μs)
MCP3009	S11MD5V	S		I_F : SC (50mA), GI (60mA)
				V_{DRM} : SC (400V), GI (250V)

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3010	S11MD5V	S		I_F : SC (50mA), GI (60mA)
				V_{DRM} : SC (400V), GI (250V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3011	S11MD5V	S		I_F : SC (50mA), GI (60mA)
				V_{DRM} : SC (400V), GI (250V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3012	S11MD5V	S		I_F : SC (50mA), GI (40mA)
				V_{DRM} : SC (400V), GI (250V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3020	S11MD5V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3020Z	S11MD5V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3021	S11MD5V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3021Z	S11MD5V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3022	S11MD5V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3023	S11MD5V	S		I_F : SC (50mA), GI (40mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3030	S11MD4V	S		I_F : SC (50mA), GI (60mA)
				V_{DRM} : SC (400V), GI (250V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3031	S11MD4V	S		I_F : SC (50mA), GI (60mA)
				V_{DRM} : SC (400V), GI (250V)

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3032	S11MD4V	S		I_F : SC (50mA), GI (40mA)
				V_{DRM} : SC (400V), GI (250V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3033	S11MD4V	S		I_F : SC (50mA), GI (40mA)
				V_{DRM} : SC (400V), GI (250V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3040	S11MD4V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3040Z	S11MD4V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3041	S11MD4V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3041Z	S11MD4V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3042	S11MD4V	S		I_F : SC (50mA), GI (40mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCP3043	S11MD4V	S		I_F : SC (50mA), GI (40mA)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				I_{FT} : Measurement condition
MCS2	S12MD1V	S		I_F : SC (50mA), GI (60mA)
				V_{DRM} : SC (400V), GI (200V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				I_{FT} : Measurement condition
MCS21	S12MD1V	S		I_F : SC (50mA), GI (60mA)
				V_{DRM} : SC (400V), GI (200V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				I_{FT} : Measurement condition
MCS2400	S12MD1V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				I_{FT} : Measurement condition
MCS2401	S12MD1V	S		I_F : SC (50mA), GI (60mA)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				I_{FT} : Measurement condition
MCT2	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (85V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (200mW)
				CTR : Measurement condition
MCT2E	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (85V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (200mW)
				CTR : Measurement condition
MCT210	PC702V			V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				CTR : Measurement condition
MCT2200	PC702V	S		V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : SC (40～320%), GI (20～60%)
MCT2200Z	PC702V	S		V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : SC (40～320%), GI (20～60%)
MCT2201	PC702VD	S		V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : SC (160～320%), GI (100～200%)
MCT2201Z	PC702VD	S		V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
				CTR : SC (160～320%), GI (100～200%)
MCT2202	PC702VB	S		V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
MCT2202Z	PC702VB	S		V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (5,300Vrms)
MCT26	PC713V	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (85V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (200mW)
				CTR : Measurement condition

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GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
MCT270	PC713V	S		I_F : SC (50mA), GI (90mA)
				V_{CEO} : SC (35V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				P_C : SC (150mW), GI (200mW)
				CTR : Measurement condition
MCT271	PC702V			V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				CTR : Measurement condition
MCT272	PC702V			V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				CTR : Measurement condition
MCT273	PC702V			V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				CTR : Measurement condition
MCT274	PC702V			V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				CTR : Measurement condition
MCT275	PC702V	S		V_{CEO} : SC (70V), GI (85V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				CTR : Measurement condition
MCT276	PC702V			V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				CTR : Measurement condition
MCT277	PC702V			V_{CEO} : SC (70V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (3,000Vrms)
				CTR : Measurement condition
MCT5200	PC713V	S		I_F : SC (50mA), GI (40mA)
				V_{CEO} : SC (35V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (200mW)
				CTR : Measurement condition
MCT5201	PC713V	S		I_F : SC (50mA), GI (40mA)
				V_{CEO} : SC (35V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (200mW)
				CTR : Measurement condition
MCT5210	PC713V	S		I_F : SC (50mA), GI (40mA)
				V_{CEO} : SC (35V), GI (45V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

GI MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (200mW)
				CTR : Measurement condition
MCT5211	PC713V	S		I_F : SC (50mA), GI (40mA)
				V_{CEO} : SC (35V), GI (45V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				P_C : SC (150mW), GI (200mW)
				CTR : Measurement condition
MCT6	PC829	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (85V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				CTR : Measurement condition
MCT61	PC829	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (85V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
MCT62	PC829	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (85V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				CTR : SC (50～400%), GI (MIN. 100%)
MCT66	PC829	S		I_F : SC (50mA), GI (60mA)
				V_{CEO} : SC (35V), GI (85V)
				V_{iso} : SC (5,000Vrms), GI (2,500Vrms)
				CTR : Measurement condition

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

HEWLETT PACKARD VS. SHARP

E : Electrical
M : Mechanical

HP MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
6N135	6N135			
6N136	6N136			
6N137	6N137			
6N138	6N138			
6N139	6N139			
HCPL2502	6N136			V_{iso} : SC (2,500Vrms, 1min.), HP (2,500Vrms, 1sec.) t_{PHL} (TYP.) : SC (0.3μs), HP (0.2μs)
HCPL2530	PC9D17	S		P_O : SC (100mW), HP (35mW) CM_H : Measurement condition
HCPL2531	PC9D17	S		P_O : SC (100mW), HP (35mW)
HCPL2630	PC9D10	S		I_F : SC (20mA), HP (30mA) P_O : SC (85mW), HP (60mW) t_{PLH} : SC (50ns), HP (45ns)
HCPL3700	PC902	S	D	I_F : SC (20mA), HP (50mA) V_O : SC (15V), HP (20V) V_{iso} : SC (5,000Vrms), HP (2,500Vrms) P_O : SC (150mW), HP (210mW) CM_H : Measurement condition Internal connection
HCPL4502	PC917	S		V_{EBO} : SC (5V), HP (5.6V) CM_H : Measurement condition

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

MOTOROLA VS. SHARP

E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
4N25	PC4N25V			
4N25A	PC4N25V			
4N26	PC4N26V			
4N27	PC4N27V			
4N28	PC4N28V			
4N29	PC4N29V			
4N29A	PC4N29V			
4N30	PC4N30V			
4N31	PC4N30V			I_F : SC (80mA), MO (60mA)
4N32	PC4N32V			
4N32A	PC4N32V			
4N33	PC4N33V			
4N35	PC4N35V			
4N36	PC4N36V			
4N37	PC4N37V			
4N38	PC702V	S		I_F : SC (60mA), MO (80mA)
				V_{CEO} : SC (70V), MO (80V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
4N38A	PC702V	S		I_F : SC (60mA), MO (80mA)
				V_{CEO} : SC (70V), MO (80V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
4N39	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (200V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
4N40	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
CNY17-1	PC702VA	S		V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (160mA), MO (150mA)
CNY17-2	PC702VB	S		V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (160mA), MO (150mA)
CNY17-3	PC702VC	S		V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				P_C : SC (160mA), MO (150mA)
CNY17-4	PC702VD	S		V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (160mA), MO (150mA)
H11A1	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11A2	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11A3	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11A4	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11A5	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11AA1	PC733	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11AA2	PC733	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11AA3	PC733	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11AA4	PC733	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				CTR : Measurement condition
H11AV1	PC112	S	D	Leadframe width
H11AV1A	PC112	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (160mW), MO (150mW)
				CTR : Measurement condition
H11AV2	PC112	S	D	Leadframe width
H11AV2A	PC112	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (160mW), MO (150mW)
				CTR : Measurement condition
H11AV3	PC112	S	D	Leadframe width
H11AV3A	PC112	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (160mW), MO (150mW)
				CTR : Measurement condition
H11B1	PC4N32V	S		I_F : SC (80mA), MO (60mA)
				V_{CEO} : SC (30V), MO (25V)
				V_{iso} : SC (2,500Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11B2	PC4N32V	S		I_F : SC (80mA), MO (60mA)
				V_{CEO} : SC (30V), MO (25V)
				V_{iso} : SC (2,500Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11B3	PC4N32V	S		I_F : SC (80mA), MO (60mA)
				V_{CEO} : SC (30V), MO (25V)
				V_{iso} : SC (2,500Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
H11C1	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (MIN. 200V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
H11C2	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (MIN. 200V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
H11C3	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (MIN. 200V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
H11C4	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
H11C5	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
H11C6	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
H11D1	PC851	S	D	I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
				Package : SC (4pin), MO (6pin)
H11D2	PC851	S	D	I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
				Package : SC (4pin), MO (6pin)
H11D3	PC851	S	D	I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (300V), MO (200V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
				Package : SC (4pin), MO (6pin)
H11D4	PC851	S	D	I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (300V), MO (200V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
				Package : SC (4pin), MO (6pin)
H11G1	PC725V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (300V), MO (100V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (300mW), MO (150mW)
				CTR : Measurement condition
H11G2	PC725V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (300V), MO (80V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (300mW), MO (150mW)

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E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				CTR : Measurement condition
H11G3	PC725V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (300V), MO (55V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (300mW), MO (150mW)
H11L1	PC900V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FHL} (MAX.) : SC (4mA), MO (1.6mA)
				〈Measurement condition : SC (R_L=280Ω, V_{CC}=5V), MO (R_L=270Ω, V_{CC}=5V)〉
H11L2	PC900V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FHL} (MAX.) : SC (4mA), MO (10mA)
				〈Measurement condition : SC (R_L=280Ω, V_{CC}=5V), MO (R_L=270Ω, V_{CC}=5V)〉
MCT2	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MCT2E	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC119	PC715V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC1005	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC1006	PC713V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC3000	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
MOC3001	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3002	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3003	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3007	S12MD1V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (200V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3009	S11MD5V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3010	S11MD5V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3011	S11MD5V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3012	S11MD5V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3020	S11MD5V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3021	S11MD5V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3022	S11MD5V	S		I_F : SC (50mA), MO (60mA)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3023	S11MD5V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3031	S11MD4V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3032	S11MD4V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3033	S11MD4V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (400V), MO (250V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3041	S11MD4V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3042	S11MD4V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3043	S11MD4V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3061	S21MD4V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3063	S21ME4	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3081	S21MD4V	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (600V), MO (800V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC3083	S21ME4	S		I_F : SC (50mA), MO (60mA)
				V_{DRM} : SC (600V), MO (800V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FT} : Measurement condition
MOC5007	PC900V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FHL} (MAX.) : SC (4mA), MO (1.6mA)
				〈Measurement condition : SC (R_L=280Ω, V_{CC}=5V), MO (R_L=270Ω, V_{CC}=5V)〉
MOC5008	PC900V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FHL} (MAX.) : SC (4mA), MO (4mA)
				〈Measurement condition : SC (R_L=280Ω, V_{CC}=5V), MO (R_L=270Ω, V_{CC}=5V)〉
MOC5009	PC900V	S		I_F : SC (50mA), MO (60mA)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				I_{FHL} (MAX.) : SC (4mA), MO (10mA)
				〈Measurement condition : SC (R_L=280Ω, V_{CC}=5V), MO (R_L=270Ω, V_{CC}=5V)〉
MOC8020	PC715V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (50V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC8021	PC715V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (50V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC8030	PC715V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (80V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC8050	PC715V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (80V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC8080	PC4N32V	S		I_F : SC (80mA), MO (60mA)
				V_{CEO} : SC (35V), MO (55V)
				V_{iso} : SC (2,500Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC8100	PC702V	S		V_{CEO} : SC (70V), MO (30V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

MOTOROLA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				P_C : SC (160mW), MO (150mW)
				CTR : Measurement condition
MOC8111	PC714V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC8112	PC714V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC8113	PC714V	S		I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (35V), MO (30V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
MOC8204	PC851	S	D	I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (300V), MO (400V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
				Package : SC (4pin), MO (6pin)
MOC8205	PC851	S	D	I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (300V), MO (400V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
				Package : SC (4pin), MO (6pin)
MOC8206	PC851	S	D	I_F : SC (50mA), MO (60mA)
				V_{CEO} : SC (300V), MO (400V)
				V_{iso} : SC (5,000Vrms), MO (7,500Vpeak)
				CTR : Measurement condition
				Package : SC (4pin), MO (6pin)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

SIEMENS VS. SHARP

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
4N25	PC4N25V			
4N26	PC4N26V			
4N27	PC4N27V			
4N28	PC4N28V			
4N32	PC4N32V			
4N33	PC4N33V			
4N35	PC4N35V			
4N36	PC4N36V			
4N37	PC4N37V			
6N138	6N139			
6N139	6N139			
CNY17-1	PC702VA			V_{iso} : SC (5,000Vrms), SI (4,400Vrms, DC)
				P_C : SC (160mW), SI (150mW)
CNY17-2	PC702VB			V_{iso} : SC (5,000Vrms), SI (4,400Vrms, DC)
				P_C : SC (160mW), SI (150mW)
CNY17-3	PC702VC			V_{iso} : SC (5,000Vrms), SI (4,400Vrms, DC)
				P_C : SC (160mW), SI (150mW)
CNY17-4	PC702VD			V_{iso} : SC (5,000Vrms), SI (4,400Vrms, DC)
				P_C : SC (160mW), SI (150mW)
CNY17F-1	PC714VA	S		I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms, DC)
				CTR : Measurement condition
CNY17F-2	PC714VB	S		I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms, DC)
				CTR : Measurement condition
CNY17F-3	PC714VC	S		I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms, DC)
				CTR : Measurement condition
H11AA1	PC733	S		I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
H11C4	S12MD1V	S		I_F : SC (50mA), SI (60mA)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{DRM} : SC (200V), SI (400V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				I_{FT} : Measurement condition
H11C5	S12MD1V	S		I_F : SC (50mA), SI (60mA)
				V_{DRM} : SC (200V), SI (400V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				I_{FT} : Measurement condition
H11C6	S12MD1V	S		I_F : SC (50mA), SI (60mA)
				V_{DRM} : SC (200V), SI (400V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				I_{FT} : Measurement condition
IL1	PC713V	S		I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				P_C : SC (150mW), SI (200mW)
				CTR : Measurement condition
ILD1	PC829	S		I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				CTR : Measurement condition
ILQ1	PC849	S		I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				CTR : Measurement condition
IL2	PC702V	S		I_F : SC (60mA), SI (100mA)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				P_C : SC (160mW), SI (200mW)
				CTR : Measurement condition
ILD2	PC829	S		I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
ILQ2	PC849	S		I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
IL5	PC702V	S		I_F : SC (60mA), SI (100mA)
				V_{CEO} : SC (70V), SI (30V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				P_C : SC (160mW), SI (200mW)
				CTR : Measurement condition
ILD5	PC829	S		I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				CTR : Measurement condition
ILQ5	PC849	S		I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				CTR : Measurement condition
IL8	PC101	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (8,000Vrms)
				P_C : SC (150mW), SI (300mW)
				CTR : Measurement condition
				Package : SC (6pin), SI (4pin)
IL9	PC100	S		I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (8,000Vrms)
				P_C : SC (150mW), SI (300mW)
				CTR : Measurement condition
IL10	PC101	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (8,000Vrms)
				P_C : SC (150mW), SI (300mW)
				CTR : Measurement condition
				Package : SC (6pin), SI (4pin)
IL11	PC100	S		I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (8,000Vrms)
				P_C : SC (150mW), SI (300mW)
				CTR : Measurement condition
IL30	PC4N32V	S		I_F : SC (80mA), SI (60mA)
				V_{iso} : SC (2,500Vrms), SI (5,300Vrms)
				P_C : SC (150mW), SI (210mW)
				CTR : Measurement condition
ILD30	PC825	S	D	V_{CEO} : SC (35V), SI (30V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
ILQ30	PC845	S	D	V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
IL31	PC4N32V	S		I_F : SC (80mA), SI (50mA)
				V_{iso} : SC (2,500Vrms), SI (5,300Vrms)
				CTR : Measurement condition
ILD31	PC825	S	D	V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
ILQ31	PC845	S	D	V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
IL55	PC4N32V	S		I_F : SC (80mA), SI (60mA)
				V_{CEO} : SC (30V), SI (55V)
				V_{iso} : SC (2,500Vrms), SI (7,500Vpeak, DC)
				P_C : SC (150mW), SI (210mW)
				CTR : Measurement condition
ILD55	PC825	S	D	V_{CEO} : SC (35V), SI (55V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				Pinout configuration
ILQ55	PC845	S	D	V_{CEO} : SC (35V), SI (55V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				Pinout configuration
IL74	PC713V	S		I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (20V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				CTR : Measurement condition
ILD74	PC829	S		I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (20V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				CTR : Measurement condition
ILQ74	PC849	S		I_F : SC (50mA), SI (60mA)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{CEO} : SC (35V), SI (20V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				CTR : Measurement condition
IL201	PC702V	S		I_F : SC (60mA), SI (100mA)
				V_{CEO} : SC (70V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				P_C : SC (160mW), SI (200mW)
				CTR : Measurement condition
IL202	PC702V	S		I_F : SC (60mA), SI (100mA)
				V_{CEO} : SC (70V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				P_C : SC (160mW), SI (200mW)
				CTR : Measurement condition
IL203	PC702V	S		I_F : SC (60mA), SI (100mA)
				V_{CEO} : SC (70V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				P_C : SC (160mW), SI (200mW)
				CTR : Measurement condition
IL205	PC316	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (120V), SI (70V)
				CTR : Measurement condition
				Package : SC (4pin), SI (8pin)
IL206	PC316	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (120V), SI (70V)
				CTR : Measurement condition
				Package : SC (4pin), SI (8pin)
IL207	PC316	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (120V), SI (70V)
				CTR : Measurement condition
				Package : SC (4pin), SI (8pin)
IL211	PC317	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				CTR : Measurement condition
				Package : SC (4pin), SI (6pin)
IL212	PC317	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				CTR : Measurement condition
				Package : SC (4pin), SI (6pin)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
IL213	PC317	S	D	I_F : SC (50mA), SI (60mA) V_{CEO} : SC (35V), SI (70V) CTR : Measurement condition Package : SC (4pin), SI (6pin)
IL215	PC317	S	D	I_F : SC (50mA), SI (60mA) V_{CEO} : SC (35V), SI (30V) CTR : Measurement condition Package : SC (4pin), SI (8pin)
IL216	PC317	S	D	I_F : SC (50mA), SI (60mA) V_{CEO} : SC (35V), SI (30V) CTR : Measurement condition Package : SC (4pin), SI (8pin)
IL217	PC317	S	D	I_F : SC (50mA), SI (60mA) V_{CEO} : SC (35V), SI (30V) CTR : Measurement condition Package : SC (4pin), SI (8pin)
IL221	PC315	S	D	V_{CEO} : SC (35V), SI (30V) CTR : Measurement condition Package : Size SC (4pin), SI (8pin)
IL222	PC315	S	D	V_{CEO} : SC (35V), SI (30V) CTR : Measurement condition Package : Size SC (4pin), SI (8pin)
IL223	PC315	S	D	V_{CEO} : SC (35V), SI (30V) CTR : Measurement condition Package : Size SC (4pin), SI (8pin)
IL250	PC314	S	D	I_F : SC (50mA), SI (100mA) V_{CEO} : SC (35V), SI (30V) V_{iso} : SC (2,500Vrms), SI (5,300Vrms) P_C : SC (150mW), SI (200mW) CTR : Measurement condition Package : Size SC (4pin), SI (8pin)
IL251	PC314	S	D	I_F : SC (50mA), SI (100mA) V_{CEO} : SC (35V), SI (30V) V_{iso} : SC (2,500Vrms), SI (5,300Vrms)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				P_C : SC (150mW), SI (200mW)
				CTR : Measurement condition
				Package : Size
				SC (4pin), SI (8pin)
IL252	PC314	S	D	I_F : SC (50mA), SI (100mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (2,500Vrms), SI (5,300Vrms)
				P_C : SC (150mW), SI (200mW)
				CTR : Measurement condition
				Package : Size
				SC (4pin), SI (8pin)
IL256	PC314		D	V_{CEO} : SC (35V), SI (30V)
				CTR : Measurement condition
				Package : Size
				SC (4pin), SI (8pin)
IL400	S12MD1V	S		I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				I_{FT} : Measurement condition
IL410	S21ME4	S		I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				I_{FT} : Measurement condition
IL420	S21ME3	S		I_F : SC (50mA) , SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				I_{FT} : Measurement condition
ILCT6	PC829	S		I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (65V)
				V_{iso} : SC (5,000Vrms), SI (7,500Vpeak, DC)
				CTR : Measurement condition
ILD32	PC825	S	D	I_F : SC (50mA), SI (80mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
ILQ32	PC845	S	D	I_F : SC (50mA), SI (80mA)
				V_{CEO} : SC (35V), SI (30V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
ILD610-1	PC826	S	D	I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
ILD610-2	PC826	S	D	I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
ILD610-3	PC826	S	D	I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
ILD610-4	PC826	S	D	I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
SFH600-0	PC702VA	S		V_{iso} : SC (5,000Vrms), SI (2,800V, 1min.)
				P_C : SC (100mW), SI (150mW)
SFH600-1	PC702VB	S		V_{iso} : SC (5,000Vrms), SI (2,800V, 1min.)
				P_C : SC (100mW), SI (150mW)
SFH600-2	PC702VC	S		V_{iso} : SC (5,000Vrms), SI (2,800V, 1min.)
				P_C : SC (100mW), SI (150mW)
SFH600-3	PC702VD	S		V_{iso} : SC (5,000Vrms), SI (2,800V, 1min.)
				P_C : SC (100mW), SI (150mW)
SFH601-1	PC702VA	S		V_{iso} : SC (5,000Vrms), SI (5,300V, DC 1min.)
				P_C : SC (160mW), SI (150mW)
SFH601-2	PC702VB	S		V_{iso} : SC (5,000Vrms), SI (5,300V, DC 1min.)
				P_C : SC (160mW), SI (150mW)
SFH601-3	PC702VC	S		V_{iso} : SC (5,000Vrms), SI (5,300V, DC 1min.)
				P_C : SC (160mW), SI (150mW)
SFH601-4	PC702VD	S		V_{iso} : SC (5,000Vrms), SI (5,300V, DC 1min.)
				P_C : SC (160mW), SI (150mW)
SFH601G-1	PC112A	S		I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300V, DC 1min.)
				P_C : SC (160mW), SI (100mW)
				CTR : SC (40～120%), SI (40～120%)
SFH601G-2	PC112A	S		I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300V, DC 1min.)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				P_C : SC (160mW), SI (100mW)
				CTR : SC (40～120%), SI (63～125%)
SFH601G-3	PC112B	S		I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300V, DC 1min.)
				P_C : SC (160mW), SI (100mW)
				CTR : SC (80～200%), SI (100～200%)
SFH601G-4	PC112B	S		I_F : SC (50mA), SI (60mA)
				V_{iso} : SC (5,000Vrms), SI (5,300V, DC 1min.)
				P_C : SC (160mW), SI (100mW)
				CTR : SC (80～200%), SI (160～320%)
SFH609-1	PC702VA	S		V_{CEO} : SC (70V), SI (90V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms, DC 1min.)
				P_C : SC (160mW), SI (150mW)
SFH609-2	PC702VB	S		V_{CEO} : SC (70V), SI (90V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms, DC 1min.)
				P_C : SC (160mW), SI (150mW)
SFH609-3	PC702VC	S		V_{CEO} : SC (70V), SI (90V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms, DC 1min.)
				P_C : SC (160mW), SI (150mW)
SFK610-1	PC817	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
SFK610-2	PC817	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
SFK610-3	PC817	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
SFK610-4	PC817	S	D	I_F : SC (50mA), SI (60mA)

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E : Electrical
M : Mechanical

SIEMENS MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
SFK611-1	PC817	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
SFK611-2	PC817	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
SFK611-3	PC817	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration
SFK611-4	PC817	S	D	I_F : SC (50mA), SI (60mA)
				V_{CEO} : SC (35V), SI (70V)
				V_{iso} : SC (5,000Vrms), SI (5,300Vrms)
				CTR : Measurement condition
				Pinout configuration

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

TOSHIBA VS. SHARP

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
4N25	PC4N25V			
4N25A	PC4N25V			
4N26	PC4N26V			
4N27	PC4N27V			
4N28	PC4N28V			
4N29	PC4N29V			
4N29A	PC4N29V			
4N30	PC4N30V			
4N31	PC4N30V			CTR : SC (500%), TO (50%)
4N32	PC4N32V			
4N32A	PC4N32V			
4N33	PC4N33V			
4N35	PC4N35V			
4N36	PC4N36V			
4N37	PC4N37V			
4N38	PC702V	S		I_F : SC (60mA), TO (80mA)
				V_{CEO} : SC (70V), TO (80V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
4N38A	PC702V	S		I_F : SC (60mA), TO (80mA)
				V_{CEO} : SC (70V), TO (80V)
				V_{iso} : SC (5,000Vrms), TO (1,775Vrms)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
6N135	6N135			
6N136	6N136			
6N137	6N137			
6N138	6N138			
6N139	6N139			
CNY17-2	PC702VB			V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
CNY17-3	PC702VC	S		V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
CNY17-4	PC702VD	S		V_{iso} : SC (5,000Vrms), TO (2,500Vrms)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				P_C : SC (160mW), TO (150mW)
TLP504A	PC829	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR (MAX.) : SC (400%), TO (600%)
TLP504A-GB	PC829	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR (MAX.) : SC (400%), TO (600%)
TLP504A-2	PC849	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR (MAX.) : SC (400%), TO (600%)
TLP504A-2GB	PC849	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
				CTR : SC (50～400%), TO (100～600%)
TLP511GA	S12MD3	S		V_{iso} : SC (1,500Vrms), TO (2,500Vrms)
				I_{FT} : SC (15mA), TO (7mA)
TLP520	PC814	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : Measurement condition
TLP520GB	PC814	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
TLP520-2	PC824	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : Measurement condition
TLP520-2GB	PC824	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : Measurement condition
TL520-4	PC844	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : Measurement condition
TLP520-4GB	PC844	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : Measurement condition
TLP521-1	PC817	S		I_F : SC (50mA), TO (70mA)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
TLP521-1A	PC817	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
TLP521-1BL	PC817CD	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
TLP521-1GB	PC817BD	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : SC (130～600%), TO (100～600%)
TLP521-1GR	PC817B	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : SC (130～260%), TO (100～300%)
TLP521-1Y	PC817A	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : SC (80～160%), TO (50～150%)
TLP521-1YG	PC817AB	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : SC (80～260%), TO (50～300%)
TLP521-2	PC827	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
TLP521-2A	PC827	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
TLP521-2GB	PC827BD	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
				CTR : SC (130～600%), TO (100～600%)
TLP521-3	PC837	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
TLP521-3A	PC837	S		V_{CEO} : SC (35V), TO (55V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
TLP521-3GB	PC837BD	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
				CTR : SC (130～600%), TO (100～600%)
TLP521-4	PC847	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
TL521-4A	PC847	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
TLP521-4GB	PC847BD	S		V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
				CTR : SC (130～600%), TO (100～600%)
TLP523	PC852	S		I_F : SC (50mA) TO (60mA)
				V_{CEO} : SC (300V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : Measurement condition
TLP523-2	PC8D52			V_{CEO} : SC (300V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
				CTR : Measurement condition
TLP523-4	PC8Q52			V_{CEO} : SC (300V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (150mW), TO (100mW)
				CTR : Measurement condition
TLP531	PC702V	S		I_F : SC (60mA), TO (70mA)
				V_{CEO} : SC (70V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP531BL	PC702V	S		I_F : SC (60mA), TO (70mA)
				V_{CEO} : SC (70V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
TLP531GB	PC702V	S		I_F : SC (60mA), TO (70mA)
				V_{CEO} : SC (70V) TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP531GR	PC702V	S		I_F : SC (60mA), TO (70mA)
				V_{CEO} : SC (70V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP531Y	PC702V	S		I_F : SC (60mA), TO (70mA)
				V_{CEO} : SC (70V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP531YG	PC702V	S		I_F : SC (60mA), TO (70mA)
				V_{CEO} : SC (70V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP532	PC714V	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
TLP532BL	PC714VC	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : SC (200～400%), TO (200～600%)
TLP532GB	PC714VBC	S		I_F : SC (50mA) TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : SC (130～400%), TO (100～600%)
TLP532GR	PC714VB	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : SC (130～260%), TO (100～300%)
TLP532Y	PC714VA	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				CTR : SC (80～160%), TO (50～150%)
TLP532YG	PC714VAB	S		I_F : SC (50mA), TO (70mA)
				V_{CEO} : SC (35V), TO (55V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : SC (80～260%), TO (50～300%)
TLP541G	S12MD1V	S		I_F : SC (50mA), TO (70mA)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				I_{FT} : SC (15mA), TO (7mA)
TLP542G	S22MD2	S		I_F : SC (50mA), TO (70mA)
				V_{DRM} : SC (600V), TO (400V)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				I_{FT} : SC (8mA), TO (7mA)
TLP543J	S22MD2	S		I_F : SC (50mA), TO (70mA)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				I_{FT} : SC (8mA), TO (10mA)
TLP545J	S22MD1V	S		I_F : SC (50mA), TO (70mA)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
TLP550	PC917			CTR (MIN.) : SC (19%), TO (10%)
				CM_H : Measurement condition
TLP551	PC918			CTR (MIN.) : SC (19%), TO (10%)
				CM_H : Measurement condition
TLP552	PC910			CTR (TYP.) : SC (1,000%), TO (700%)
				CM_H : Measurement condition
TLP560G	S11MD5T			V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				I_{FT} : Measurement condition
TLP570	PC715V	S		I_F : SC (50mA), TO (70mA)
				V_{iso} : SC (5,000Vrms), TO (2,500Vrms)
				CTR : Measurement condition
TLP571	PC4N32V	S		I_F : SC (80mA), TO (70mA)
				V_{CEO} : SC (30V), TO (35V)
				CTR : Measurement condition
TLP575	PC4N32V	S		I_F : SC (80mA), TO (60mA)
				V_{CEO} : SC (30V), TO (35V)
				CTR : Measurement condition
TLP576	PC715V	S		I_F : SC (50mA), TO (60mA)
				CTR : Measurement condition
TLP620	PC814	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				CTR : Measurement condition
TLP620GB	PC814	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				CTR : Measurement condition
TLP620-2	PC824	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
				CTR : Measurement condition
TLP620-2GB	PC824	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
				CTR : Measurement condition
TLP620-4	PC844	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
				CTR : Measurement condition
TLP620-4GB	PC844	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
				CTR : Measurement condition
TLP621	PC817	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
TLP621GB	PC817BD	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				CTR : SC (130～600%), TO (100～600%)
TLP621-2	PC827	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
TLP621-2GB	PC827BD	S		V_{CEO} : SC (35V), TO (55V)
				P_{tot} : SC (150mW), TO (100mW)
				CTR : SC (130～600%), TO (100～600%)
TLP621-3	PC837	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
TLP621-3GB	PC837BD	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
				CTR : SC (130～600%), TO (100～600%)
TLP621-4	PC847	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
TLP621-4GB	PC847BD	S		V_{CEO} : SC (35V), TO (55V)
				P_C : SC (150mW), TO (100mW)
				CTR : SC (130～600%), TO (100～600%)
TLP627	PC852	S		I_F : SC (50mA), TO (60mA)
				CTR : Measurement condition

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
TLP627-2	PC8D52			P_C : SC (150mW), TO (100mW)
				CTR : Measurement condition
TLP627-4	PC8Q52			P_C : SC (150mW), TO (100mW)
				CTR : Measurement condition
TLP630	PC733	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				CTR : Measurement condition
TLP630GB	PC733	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				CTR : Measurement condition
TLP631	PC702V			V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP631GB	PC702V			V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP632	PC714V	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
TLP632GB	PC714VBC	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (35V), TO (55V)
				CTR : SC (130～400%), TO (100～600%)
TLP635	PC112	S	D	I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
				Leadframe width
TLP635GB	PC112	S	D	I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
				Leadframe width
TLP635F	PC112	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP635F-GB	PC112	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				CTR : Measurement condition
TLP636	PC113	S	D	I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
				Leadframe width
TLP636GB	PC113	S	D	I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
				Leadframe width
TLP636F	PC113	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP636F-GB	PC113	S		I_F : SC (50mA), TO (60mA)
				V_{CEO} : SC (70V), TO (55V)
				P_C : SC (160mW), TO (150mW)
				CTR : Measurement condition
TLP641G	S12MD1V			I_{FT} : SC (15mA), TO (7mA)
TLP641J	S22MD1V			
TLP650	PC917	S		V_{iso} : SC (2,500Vrms), TO (5,000Vrms)
				CTR (MIN.) : SC (19%), TO (10%)
				CM_H : Measurement condition
TLP651	PC918	S		V_{iso} : SC (2,500Vrms), TO (5,000Vrms)
				CTR (MIN.) : SC (19%), TO (10%)
				CM_H : Measurement condition
TLP666G	S21ME4	S	D	V_{DRM} : SC (600V), TO (400V)
				I_{FT} : Measurement condition
				Package : SC (6pin), TO (5pin)
TLP666GF	S21ME4F		D	V_{DRM} : SC (600V), TO (400V)
				I_{FT} : Measurement condition
				Package : SC (6pin), TO (5pin)
TLP666J	S21ME4	S	D	I_{FT} : SC (7mA), TO (10mA)
				Package : SC (6pin), TO (5pin)
TLP666JF	S21ME4F	S	D	I_{FT} : SC (7mA), TO (10mA)
				Package : SC (6pin), TO (5pin)
TLP2530	PC9D17			P_C : SC (45mW), TO (35mW)

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				CTR (MIN.) : SC (19%), TO (7%)
				CM_H : Measurement condition
TLP2531	PC9D17			P_C : SC (45mW), TO (35mW)
				CM_H : Measurement condition
TLP2601	6N137	S		P_C : SC (85mW), TO (40mW)
				CMR (TYP.) : SC (500V/μs), TO (10kV/μs)
TLP2630	PC9D10	S		I_F : SC (20mA), TO (15mA)
				P_C : SC (40mW), TO (60mW)
				CM_H : Measurement condition

"Blank" : Direct Replacement, "S" : Similar, "D" : Different

E : Electrical
M : Mechanical

TOSHIBA MODEL NO.	SHARP MODEL NO.	E	M	DIFFERENCE
				CTR (MIN.) : 5C (195%), TO (7%) CM_R : Measurement condition
TLP2531	PC9D17			P_C : 5C (45mW), TO (35mW) CM_R : Measurement condition
TLP2601	6N137	S		P_C : 5C (85mW), TO (40mW) CMR (TYP.) : 5C (500V/μs), TO (10kV/μs)
TLP2630	PC9D10	S		I_F : 5C (20mA), TO (15mA) P_C : 5C (40mW), TO (60mW) CM_R : Measurement condition

"Blank" : Direct Replacement, "S" : Similar, "D" : Different